Chapter 6. Environmental Consequences (Environmental Effects and Alternative Comparisons)

Introduction

This chapter addresses the environmental consequences (or effects) of implementing the proposed management direction (chapter 4) of all alternatives (chapter 5). Where impacts were identified that require mitigation, the mitigation measures have been incorporated into chapter 4. The management plan is configured to maximize benefits and minimize adverse effects on both ecosystem function and the human environment. Nevertheless, some unavoidable adverse effects would result from some of the proposed or alternative actions. For example, some of the actions proposed would have some short-term adverse effects. However, when judging the significance of short-term impacts, expected long-term benefits on ecosystem health must be considered. For example, because of the limited portion of each watershed that is treated annually, a first-year increase in sediment yield from proposed road decommissioning projects, followed by a permanent, long-term major reduction in sediment yield, would not be considered a significant adverse effect. On the other hand, adverse effects that would be of a repetitive nature in perpetuity, such as human degradation of critical habitat for threatened or endangered species caused by trail construction and backcountry hiking, may be considered significant adverse effects.

Adverse effects may include direct impacts, indirect impacts, or cumulative impacts. In each section below, the foreseeable impacts of these three types are addressed together as needed. For the proposed actions, cumulative effects on ecosystem function are all beneficial, obviating the need for a specific discussion of cumulative effects. For some of the alternatives, however, significant direct, indirect, or cumulative effects on ecosystem function may occur.

As noted, the significance of direct, indirect, or cumulative adverse effects is determined by weighing together both short-term and long-term effects. Criteria and reasoning for determining significance are described within the significance discussions of each potential impact (rather than being set forth separately beforehand).

As noted in chapter 1, the baseline for measuring impacts is the current condition of the Reserve under the interim management policy, which is described in chapter 3. Thus, the impact of a proposed action on either ecosystem function or the human environment that involves continuation of interim management would be considered in this assessment to have no net effect, either beneficial or adverse. The selected baseline is required both by CEQA and by ESA and CESA and can be employed under provisions of NEPA if it is considered a reasonable and appropriate baseline.

Effects Summary

Implementation of the proposed plan would result in substantial beneficial changes to the Reserve's ecosystems and to the public's ability to experience them. Implementation of some of the alternatives would have significant adverse effects on the Reserve's ecosystems, and even though they may benefit some user groups, these alternatives would not be introduced into the Reserve. Benefits and adverse effects of each program element on the various resources are summarized in table 6-1.

Species Management

As discussed in chapter 4, restoration of ecosystem processes and function and preservation of old-growth and riparian dependent species are the cornerstones of Reserve management. Species management is actually carried out, however, by actions under the other major program areas. The purpose of actions such as watershed and forest restoration is to directly benefit ecosystem processes and function; actions such as closing portions of the Reserve to visitors on a seasonal and hourly basis are meant to avoid adversely affecting ecosystem processes and function. Accordingly, specific impacts on ecosystem and species processes are discussed under each of the various other program elements below. In this section, only the general effects on ecosystem and species integrity are addressed.

Under all alternatives, vegetation at the Reserve will advance to later successional stages. Because of past timber harvesting, less than half of the Reserve presently provides old-growth habitat. Harvested lands include some mature seral stages, but large acreages of both shrub-sapling habitat and pole habitat are present. Moreover, an extensive system of logging roads traverses these harvested lands, which are populated by plant and animal species that prefer more open habitats compared to old-growth forest habitat. Thus, habitat for species associated with young forests, forest openings, and disturbed areas will diminish through time under all alternatives. Correspondingly, habitat for old-growth-dependent species will increase through time under all alternatives. This effect would happen more quickly under Alternatives 1A or 1B and 2A or 2B than under the no-action restoration alternatives (1C and 2C).

Effects of Species Management on Special-Status Species

All of the special-status plant and animal species known to occur in the Reserve prefer or require late-successional and old-growth forest habitat. Of all potential special-status species that could occur on the Reserve, none prefer brushlands or early-successional forest. Under all alternatives, old-growth habitat will gradually increase in extent from the current 42% of the Reserve to nearly 100%, over the long term. In general, the proposed management and all alternatives will tend to result in net benefits to special-status species over time. This expected effect could be reduced, however, by increased levels of human access under some alternatives that could degrade both terrestrial and aquatic habitats. For example, closures required to avoid disturbance to nesting spotted owls and marbled murrelets may be effective in preventing direct impacts, but, under some alternatives, closure enforcement would be difficult or indirect adverse effects may be induced (i.e., those alternatives that diminish control of [prohibited] off-trail hiking or induce colonization of the Reserve by corvids). Under access Alternatives 3A and 4A, in particular, adverse habitat effects may offset gains in habitat extent, resulting in a significant adverse effect on special-status species that inhabit the Reserve.

Effects of Species Management on Common Species

Under all alternatives, and especially under the restoration alternatives, populations of species associated with open habitats would tend to diminish through time. Because most of these species are common, the direct effect is less than significant. In addition, because such early-successional habitats are widespread throughout adjoining timberlands, the potential adverse cumulative effect is also considered less than significant.

Effects of Species Management on Recreation

Public visitation and interpretation is a beneficial component of all management alternatives. However, hourly closures of portions of the Reserve to minimize disturbance of murrelet and spotted owl nesting are imposed under current management and would be imposed under all alternatives. These closures cause some reduction in the availability of the Reserve for human use, though the effect on total visitation and opportunities foregone is considered very small. Because no change in management would occur, no consequences will result.

Watershed Restoration

Effects of Watershed Restoration on Water Quality and Aquatic Species

Effects of Management Common to All Watershed Restoration Alternatives

Benefits

Under all three watershed restoration alternatives, sediment input to the Reserve's streams will be reduced by

- stabilizing roads, skid trails, and log landings;
- fully excavating stream crossings; and
- stabilizing slopes that have been subject to landslides.

Furthermore, emergency sediment reduction actions will prevent catastrophic inputs of sediments into streams. These efforts to restore natural hydrologic and sediment processes within disturbed watersheds will result in the improved quality of these aquatic habitats, as described below.

Revegetation and road stabilization in watersheds adversely affected by timber harvest and related activities have been shown to substantially reduce surface and landslide erosion. This reduction in erosion leads to improvements in downstream fish habitat because of the corresponding reduction in sediment yield to watercourses (Reeves et al. 1991). As sediment input to the streams is reduced, the amount of available energy in the stream to mobilize the accumulated sediment will gradually increase, resulting in pool scouring and the flushing of existing fine sediments from stream gravels. These changes will improve conditions for anadromous fish spawning and rearing.

Stream sediment, whether settled or suspended, can damage aquatic habitats and reduce fish production, growth, and survival. Fine sediments deposited in gravels can lower spawning success (by reducing egg survival and trapping emerging fry) or reduce the availability of food in streams (by limiting primary production and invertebrate abundance). Fine sediment that remains in suspension increases turbidity, which can increase fish mortality, reduce feeding opportunities for sight-feeding fish (including salmonids), and lower fish production by causing fish to avoid biologically important habitat or delay migration to upstream spawning habitats.

Coarse sediment can alter channel beds, channel geometry, and bank erosion rates. Stream reaches that become aggraded (i.e., accumulate bed materials) with coarse sediments typically become wider and shallower, with more riffle habitat area and less pool habitat area, volume, and depth (Hicks et al. 1991). Steelhead and coho salmon abundance correlate positively with pool habitat area, volume, and depth.

Potential Adverse Effects

The use of heavy equipment for watershed restoration has the potential to cause stream contamination from accidental spills of fuel, lubricant, or oil. These spills can occur during equipment operation, maintenance, or refueling. Implementation guidelines for watershed restoration in chapter 4 are expected to make the probability of such an event highly unlikely; therefore, the adverse effect would be less than significant.

During rainy periods after restoration actions are taken, the potential will exist for newly disturbed soils to erode and contribute sediment to streams. Such erosion would be considerably less than that presently occurring (Madej 2001). The potential will primarily exist until disturbed soils become revegetated (Madej 2001), generally about two years following disturbance in the Reserve's wet, warm climate. In the interim, the lopping and scattering of removed vegetation and rice straw as mulch over the disturbed soils surfaces will provide partial protection for exposed soils.

At removed stream crossings, some sediment input to streams or ephemeral runoff will generally occur as the channel morphology undergoes some natural adjustment. Because the original

stream profile is reestablished, the magnitude of the adjustment will be relatively small and rapid. Moreover, the areas of disturbed channel are relatively small.

Implementation guidelines described in chapter 4 will limit watershed restoration activities to nonrainy periods when less-sensitive fish life stages are present, and the likelihood of introducing sediments to waterways is at a minimum. These guidelines and other implementation guidelines will assure that the potential short-term effect of increased stream sedimentation immediately following restoration will be less than significant.

Relative Effects of the Watershed Restoration Alternatives

Benefits

The benefit of road restoration is improved aquatic habitat conditions resulting from enhanced watershed stability. Watershed stability is most directly related to the volume of earth relocated during restoration. Under Alternative 1A (full-recontour watershed restoration), twice as much earth would be moved as under Alternative 1B (hydrologic-stabilization watershed restoration) (1.2 versus 0.6 million cubic yards)(table 4-1). Under Alternative 1C, restoration would cease at only 0.2 million cubic yards.

In addition to earthwork volume, final configuration, risk of instability, and aesthetics are key variations among alternatives. The primary benefits of full recontouring (Alternative 1A) are reestablishment of natural surface flow and eliminating interception of surface drainage. This in turn enhances stability and aesthetic value. Even though Alternative 1B entails hydrologic stabilization and enhanced stability, the risk of and, consequently, the long-term frequency of slope failures are higher under Alternative 1B because existing road prisms are largely retained. Over the long term, slope failures under Alternative 1B may require additional access and treatment operations or could result in additional sedimentation. Therefore, considering both volume and stability, the three alternatives would provide differing levels of benefit to downstream aquatic habitats. These benefits come at similarly varying costs (table 4-8). Full recontouring (Alternative 1A) is presently the primary approach used by the California Department of Parks and Recreation, and by the Redwood National Park for the redwood parks in the north coast region, primarily because parklands should not continue to contain roads used for timber management and because repeated entry is costly.

Potential Adverse Effects

The potential adverse effects of watershed restoration are directly related to the area of soil disturbed under a particular alternative. Under Alternative 1A (full recontouring) and Alternative 1B (hydrologic stabilization), the extent of treated roads, stream crossings, landings, and landslides would be about the same. Under Alternative 1A, the portion of the watershed disturbed by watershed restoration would be 5.2%, whereas under Alternative 1B, because the average width of restoration is less, it would be 4.6% (table 6-2). By exposing an additional 43 acres of land (an additional 13% of disturbed acreage) at a rate of perhaps 10 acres more per year, finished soil surfaces under Alternative 1A would be slightly more susceptible to surface erosion than under Alternative 1B. Under Alternative 1C, about one-third as much soil would be exposed.

Under all alternatives, mulch would be applied to the disturbed surfaces, and other implementation guidelines given in chapter 4 would be employed. Soil erosion at road

restoration sites in the north coast region employing similar approaches has not generally been a significant problem (Casaday pers. comm.). Natural regeneration rapidly provides ground cover in the warm, wet climate, and revegetation maintenance is focused on thinning rather than stimulating growth. A very intense rainfall on a recently disturbed site is always a potential occurrence. However, considering the Reserve's watersheds as a whole, the potential for significant erosion of soils disturbed by watershed restoration under each of the alternatives is small. Accordingly, the potential adverse effect on aquatic habitats caused by watershed restoration under all alternatives is considered less than significant.

Effects of Watershed Restoration on Forest Structure and Old-Growth Characteristics

All watershed restoration action alternatives would eventually result in an approximate 5% increase (341–384 acres) in the extent of old-growth habitat relative to current conditions (table 6-2). Under the no-action alternative (1C), natural development of old growth would be slowed by periodic slope failures along the extensive system of abandoned logging roads in the Reserve. Under the action alternatives (1A, 1B), existing vegetation that has already colonized abandoned roads and landings would be removed and used for mulch, but tree species would be planted or would rapidly colonize the stable sites. Because of ripping or filling of stabilized road surfaces, the increase in old-growth forest would be substantially accelerated. The effect would be similar between the two action alternatives.

Table 6-2. Extent of Watershed Restoration

Watershed	Condition	Area to be Disturbed[a] (acres)	Watershed Area (acres)	Percent of Watershed Area[a]
Upper Little South Fork Elk River	Nearly all unharvested (northern portion of central grove)	12–15	1,500	0.8–1.0
Salmon Creek	Both unharvested (southern portion of central grove) and harvested	181–201	3,000	6.0–6.7
Upper South Fork Elk River	Both unharvested (eastern grove) and harvested	77–89	1,300	5.9–6.8
Lower Little South Fork Elk River	All harvested	71–79	1200	5.9–6.6
Elk River Corridors	Harvested and riparian	0	400	0
Entire Reserve	--	341–384	7,400	4.6–5.2

Note: The distribution of watershed restoration can be seen on figure 4-2. Restoration will include reforestation (planting and thinning disturbed restoration sites).

[a] Range is from Alternative 1B - Hydrologic Stabilization to Alternative 1A - Full Recontour.

Effects of Watershed Restoration on Special-Status Plants

Special-Status Vascular Plant Species

As noted in chapter 3, no field surveys have been conducted to identify special-status plants in the Reserve. During other survey work in the Reserve, a single population of heart-leaved twayblade, a CNPS list four species, was observed (Wheeler pers. comm.).

Restoration involves previously disturbed environments, which have a low probability of supporting special-status plant populations in this region. If special-status species are believed to be present, avoidance measures will be implemented if technically feasible. If measures are not technically feasible, populations will be transplanted to suitable habitats under the direction of a qualified botanist. With these measures available, the potential direct adverse effect of watershed restoration on special-status plant species, should any be present, will be less than significant.

If populations of special-status plants are present in wetlands, wet meadows, or riparian areas downstream from restoration sites, the restoration projects may indirectly result in a benefit to these species by reducing the probability of sedimentation or scouring of these populations.

As vegetation naturally established on abandoned roads or planted on decommissioned or removed road surfaces trends toward later-successional forest stages and as stream channels downstream become more stable over time, the habitats gained under all alternatives will be more likely to support special-status species than the habitat that was lost. Roaded and logged forest lands suffering stream sedimentation are widespread in the region, but unroaded, unharvested old growth is of limited extent. This ratio of roaded to unroaded land will contribute to threatened and listed species favoring undisturbed, later-successional forest stages. Thus, under all alternatives, watershed restoration will in general benefit special-status plant species that may occur in the Reserve. Alternatives 1A and 1B would stabilize much more roadway substrate than would Alternative 1C, thereby resulting in a relatively faster rate of development of suitable habitat for special-status plant species.

Survey-and-Manage Cryptogam Species

Survey-and-Manage cryptogam species in the Reserve include fungi and lichens and may include bryophyte species. These species are generally associated with old-growth forest types and have a low potential to occur in previously disturbed areas proposed for watershed restoration action. Watershed restoration action would therefore be very unlikely to directly adversely affect Survey-and-Manage cryptogams. Over the long term, watershed restoration will accelerate recovery of old-growth habitats and downstream riparian habitats that are needed by the Survey-and-Manage cryptogam species.

Effects of Watershed Restoration on Invasive Nonnative Plants

Watershed restoration actions will require the removal of existing vegetation and the exposure of soils along abandoned roads, landings, and skid trails. Such changes have the potential to create conditions favorable for establishment of invasive nonnative plants. However, use of implementation guidelines in chapter 4 (under “Species Management—Invasive Nonnative Plants” and “Recreation Management”) will likely prevent weed propagation, dispersal, and establishment in the restoration sites. If plants do colonize a site, they can be removed as a part

of normal weeding during the revegetation maintenance period. The potential adverse effect is therefore less than significant. Over the long term, watershed restoration is expected to result in a beneficial effect by promoting reestablishment of stable natural forest vegetation, which excludes invasive, nonnative plants.

Effects of Watershed Restoration on Wildlife

Effects of Management Common to All Watershed Restoration Activities

Long-term benefits of watershed restoration on wildlife resources will be enhancement of downstream and downslope riparian habitats, recolonization of native forest vegetation along former logging roads, and reduction in forest fragmentation caused by these roads.

Restoration actions can result in temporary disturbance to roadbed and roadbed edge habitat for common species and noise disturbance to breeding birds. However, breeding-period closures and other implementation measures described in chapter 4 will minimize breeding disturbance to species identified as threatened, endangered, candidate, sensitive, or otherwise of special status.

In the following sections, effects on various wildlife species or groups are described.

Common Wildlife

The primary long-term effect of watershed restoration on common wildlife will be an overall increase in quality habitat for species that depend on old-growth forests habitat and, specifically, wildlife species that depend on stable aquatic habitats for meeting all or part of their biological needs. Common amphibians and mollusks (refer to Chapter 3 for a list of common wildlife) are the species that will benefit the most from the proposed watershed restoration activities.

Alteration of roadbeds, landings, and skid trails and removal of stream crossings might temporarily disturb wildlife species that are adapted to shrub habitats, using these roads as dispersal corridors, or inhabiting the stream crossings. Temporary and isolated disturbance to this small quantity of habitat is considered less than significant because it will not result in a substantial reduction in local populations of common wildlife species.

A short-term impact that could result from the project is the potential for noise disturbance from restoration activities to interrupt normal breeding behavior in common birds. Limited operating periods established for federally listed birds and mitigation measures established for migratory birds (discussed below) will prevent noise disturbance to breeding common birds.

Migratory Birds

As with common wildlife species, the long-term indirect effect of watershed restoration will be the reduction in the amount of suitable habitat for migratory bird species adapted to edges and disturbed areas, such as American robins and dark-eyed juncos. Because these species are considered locally and regionally abundant and widely distributed, reducing the amount of available, suitable habitat is not expected to reduce or eliminate populations.

Very little direct impact on breeding migratory birds would be expected to occur as a result of watershed restoration activities. Approximately 60% of the watershed restoration activity would be restricted to limited operating periods established for nesting marbled murrelets and northern spotted owls (figures 3-6 and 3-7). Adverse impacts on a limited area may occur on an infrequent basis.

Marbled Murrelet and Northern Spotted Owl

Removal of roadbeds will benefit marbled murrelet and northern spotted owl. As discussed in chapter 3, corvids, which require edge habitats, are efficient nest predators that pose a threat to the survival of the marbled murrelet. Watershed restoration will accelerate the reduction in edge habitats and help reduce or preclude corvid intrusion.

No direct removal of suitable marbled murrelet or northern spotted owl habitat would occur during watershed restoration activities. Noise disturbance from restoration activities, however, has the potential to interrupt normal breeding behavior of the marbled murrelet and northern spotted owl. Watershed restoration actions that may cause visual or auditory disturbances that are not adequately dampened by vegetative or topographic screening will be restricted by distance buffers of up to 0.25 mile from occupied or suitable habitat of marbled murrelets or northern spotted owls. If buffers cannot be used effectively, limited operating periods will be imposed (September 15–March 23 for murrelet habitat and July 31–January 31 for northern spotted owls).

In some instances, the situation may require a limited amount of incidental take, by disturbance; this will be dealt with on a case-by-case basis through consultation.

Bald Eagle and Osprey

Bald eagle or osprey habitat will not be significantly enhanced by restoration action. The increasing fish populations on the Reserve are in habitats that are largely unsuitable for these species' feeding.

Bald eagle or osprey nesting or roosting habitat will not be affected by the proposed restoration activities. Because eagles have not been using the Reserve for nesting and are mobile, the potential for noise to disturb the species is minor. If, however, a bald eagle or osprey nest were located in the Reserve before restoration activities were begun or completed, appropriate avoidance measures would be implemented until the young had fledged.

Amphibians and Reptiles

Restoration of aquatic ecosystems will benefit species that depend on the aquatic or riparian environments for all or part of their biological needs. Long-term beneficial effects on amphibians and reptiles from watershed restoration activities include

- reducing sediment in streams,
- maintaining cooler water temperatures, and
- enhancing riparian vegetation.

Species such as torrent salamanders and tailed frogs are sensitive to increased water temperature and sedimentation. Removal of stream crossings and reduction of sediment yield in streams will increase available suitable habitat for these and other amphibians in the Reserve.

Restoration activities in or adjacent to riparian and aquatic habitats that support these species have the potential to disturb or harm individual animals. However, avoidance measures (chapter 4) will reduce this impact.

Survey-and-Manage Wildlife Species

Enhancement of old-growth habitat and maintenance of a canopy cover near riparian areas will benefit the Del Norte salamander. Because of improved stability over time, restoration activities will produce a moister microclimate through an increase in canopy closure, enlarging the extent of suitable habitat for this species.

Roadbed decommissioning will generally not affect suitable habitat for the Del Norte salamander; however, if rocky areas are to be disturbed, a small, isolated, and unquantified number of individuals may be taken.

Relative Effects of the Watershed Restoration Alternatives

Under Alternatives 1A and 1B, roads and landings having significant sediment yield would be fully recontoured and revegetated, and stream crossings would be restored. Long-term benefits under these alternatives would consist of enhanced stability of riparian and aquatic habitats, benefiting especially those species that depend on late-successional forest. Moreover, the alteration of existing roads would accelerate the reduction in edge habitat for nest predators, benefiting both common and special-status bird species.

Under Alternative 1C, watershed restoration would not extend beyond the Year 2002. As a result, approximately two-thirds of the prerestoration sediment yield would continue to degrade riparian and aquatic communities and diminish their wildlife resources. Edge habitat created by the road system would diminish, but it would diminish slowly over two-thirds of the road system.

The alternatives vary in the amount of terrestrial habitat that must be modified to implement watershed restoration. Alternative 1A would affect modification of 384 acres, compared to 341 acres for Alternative 1B2 (13% less). Alternative 1C would not extend watershed restoration activities beyond the Year 2002. As a result, only about two-thirds of the roadway habitats would be modified, and habitat intrusion by mechanized equipment would extend over half as many years.

Under even the more intensive alternatives (1A and 1B), temporary and isolated disturbance of the small quantities of early-successional habitat (approximately 40–60 acres per year) would not be expected to reduce the number or range of any common or special-status species. The habitat affected is a very common habitat on lands surrounding the Reserve. Disturbance to both common and special-status nesting birds would be avoided by limiting operating periods and implementing other species management and watershed restoration implementation guidelines (chapter 4). Based on the type of habitat affected and the avoidance measures adopted, short-term habitat and wildlife disturbance impacts under all alternatives are considered less than significant.

Effects of Watershed Restoration on Fire Suppression

Roads to be removed or stabilized on the Reserve are, in general, not available for use by vehicles and therefore would play only a minor role in any fire suppression incident at the Reserve. A network of defensible roads used for timber management in the area will continue to provide access into and around the Reserve. Effects of watershed restoration under all alternatives would have a less-than-significant effect on the nature of fire suppression proposed for the Reserve (chapter 4).

Effects of Watershed Restoration on Recreation Activities

One benefit of watershed restoration will be the opportunity to provide recreation services to the public. Watershed restoration is of interest to the public, and implementation projects provide a good opportunity for guided tours.

Restoration activities will sometimes require the closure and detour of some of the trails that may otherwise be open to public use. Noise from heavy mechanized equipment and chain saws may be annoying to users of adjacent areas. These effects, under all alternatives, would be temporary and would not be expected to significantly reduce or degrade visitation to the Reserve.

Effects of Watershed Restoration on Cultural Resources

Before watershed restoration projects are implemented, work areas will be surveyed for cultural resources, and if any are encountered, the project will be modified based on evaluation by a qualified archaeologist.

Undiscovered cultural resources could be encountered during earthwork conducted as part of watershed restoration. However, most of the earthwork will be conducted in highly disturbed areas (i.e., along former logging roads and associated areas affected by landslides). The likelihood of disturbance of undiscovered cultural resources is therefore relatively low. As noted in chapter 4, if any cultural materials or sites are encountered during ground-disturbing activities, all work will be stopped until a qualified archaeologist has evaluated the find. Accordingly, potential direct impacts on cultural resources are considered less than significant. No potential indirect impacts have been identified.

Forest Restoration

Effects of Forest Restoration on Forest Structure and Old-Growth Characteristics

Effects of Management Common to the Forest Restoration Action Alternatives

The two forest restoration action alternatives (2A and 2B) would entail *density management*, or thinning, of shrub-sapling stands (both alternatives) and pole stands (2A only) in harvested areas

of the Reserve. These actions would be expected to beneficially accelerate seral-stage succession and the development of old-growth characteristics in these harvested stands.

Observed Benefits of Density Management

Redwood and redwood/Douglas-fir stands naturally develop old-growth characteristics over time through the process of succession. Natural thinning of the number of trees in a stand is central to this succession. The shrub/sapling stage in the Reserve generally has 500–3,000 trees per acre (Harrison pers. comm., Bailey 1998), whereas the tertiary stage of this vegetation type typically has approximately 60–80 dominant trees per acre (Collopy pers. comm.). Allowing the stand to thin naturally requires approximately 100–200 years for old-growth stand characteristics to develop, and trees that die in the process remain in the stand structure and greatly increase RSRF.

The benefits of artificial thinning to increase stand productivity and reduce RSRF are well documented in the forest-management literature. Carey (1996) noted that the lack of management after a timber harvest "delayed forest development, compared to thinning with other management techniques." Scanlon (1992) determined that, in the redwood forests of the Jackson Demonstration State Forest, site quality and amount of available light were the primary constraints on growth. He went on to conclude that thinning was an appropriate means to increasing available light for retained trees and that "a proper thinning prescription applied to a timber stand can be instrumental in achieving management goals." In a study where thinning in second-growth redwood/Douglas-fir was conducted at four intensities, Oliver et al. (1994) found significant increases in growth parameters as thinning intensity increased, and he noted that leave trees responded with increased growth rates that correlated well with the intensity of thinning.

Thinning can be implemented in two ways: single-tree thinning or variable-density thinning. Single-tree thinning is a uniform approach that leaves fewer trees with wider spacing and a regular distribution. The proposed variable-density thinning (see the "Implementation Guidelines" section under "Forest Restoration" in chapter 4) is a variable approach that thins more heavily in some areas than in others to create a mosaic of densities. Both types of thinning have cognates in natural processes. Single-tree thinning naturally takes place in closely spaced, even-aged stands between the ages of 10 and 80 years. In these stands, individual tree mortality is generally the result of being outcompeted for light, moisture, and/or nutrients. The mortality of these individuals is usually uniformly distributed and leaves a residual stand with evenly spaced trees. The natural model for variable-density thinning is the creation of an opening in the forest canopy by some catastrophic event: windthrow, spot fire, insect or disease focus, or toppling of a large old individual. The result is creation of a small area where light, nutrients, and moisture are available at the surface of the soil, and vegetation suitable to these new conditions populates the site.

Forest stand response to single-tree thinning has been studied primarily from a commercial productivity standpoint, and the advantages in terms of increased growth and survival of residual trees is well documented (Bailey 1998, Oliver 1992, Lindquist 1999, Cussins n.d.). Variable-density thinning, as a prescribed management tool, has not been extensively addressed in the literature. However, its roles in acceleration of growth, the development of structural characteristics of old-growth stands, and increased species diversity has been noted (Carey 1999 and 2000, Sugihara 1992, Piirto n.d.). Adams et al. (n.d.) noted that they observed faster growth rates for all types of group selection (small opening) harvests.

Expected Benefits to the Reserve

For harvested stands in the Reserve, it is anticipated that thinning would accelerate the development of favorable structural characteristics from 100–200 years in untreated stands to approximately 50 years in treated stands. The actual benefit would depend on the thinning program adopted (2A or 2B). Thinning of trees in shrub-sapling stands in seed-tree harvested stands could result in the development of old-growth stand characteristics within 30 years. Pole harvested stands could begin to develop these characteristics in 15–30 years, and such characteristics would begin to develop in the shrub-sapling stands within 30–50 years.

The development of old-growth characteristics, both of individual trees and communities, would result from

- the retention of dominant trees and elimination of slower growth individuals,
- faster tree growth by selected dominant trees as they are released from competition for sunlight and moisture,
- fuller development of tree crowns, and
- variable spacing allowing light penetration.

Proper sizing and topographic placement of the openings would result in increased side lighting and the retention of side branches of selected dominant trees, important features of old-growth forests. Variable spacing would increase species richness by creating opportunities for plant colonization and by contributing woody debris to the forest floor. The more diverse plant communities that are created would be more resistant to catastrophic influences.

Potential Adverse Effects

Removal of up to 75% of the stems under either thinning approach would elevate the risk of loss of individuals and small stands to windthrow. Such losses are not expected to be significant over the long term.

Reduction of the overall number of individual trees during thinning increases the relative importance of the loss of individual trees in the future because of snow breakage, disease, or fire. This increased risk of insufficient numbers of trees is unavoidable, but the probability that tree numbers become limited at the Reserve is very low.

Variable tree spacing would result in colonization of native species, such as blue blossom and tanoak, and invasive nonnative species, such as pampas grass and broom. Such colonization may increase costs of stand maintenance or reduce the competitive advantage of the desirable legacy individuals and increase the time required to attain the desired old-growth stand characteristics. The presence of native colonizers on a limited scale is considered beneficial, but their widespread colonization in openings or a propensity for colonization by invasive nonnative plants would result in a revision to opening specifications and/or other variable-thinning prescription elements. Because of the ability to modify prescriptions through adaptive management, this potential impact is considered less than significant.

Relative Effects of the Forest Restoration Alternatives

Expected Benefits

The extent of forest restoration would differ considerably between the two action alternatives (table 6-3). Under Alternative 2A, the benefits of density management described above could be realized on up to 2,500 acres, consisting of 57% of the harvested stands and nearly one-third of the entire Reserve. Under Alternative 2B, lesser benefits could be realized on approximately 850 acres, consisting of 20% of the harvested stands, or 11% of the entire Reserve. The no-action alternative (2C) would achieve no such benefit.

Table 6-3. Extent of Forest Restoration Candidate Areas

Watershed	Condition	Area[a] (acres)	Percent of Watershed[a]
Upper Little South Fork Elk River (1,500 acres)	Unharvested	1,485	99
	Harvested, mature	0	0
	Harvested, potentially thinned	0	0
	Watershed restoration revegetation	12–15	0.8–1.0
Salmon Creek (3,000 acres)	Unharvested	1,067	36
	Harvested, mature	0	0
	Harvested, potentially thinned	424–1,732	14–58
	Watershed restoration revegetation	181–201	6.0–6.7
Upper South Fork Elk River (1,300 acres)	Unharvested	400	31
	Harvested, mature	217	17
	Harvested, potentially thinned	372–594	29–47
	Watershed restoration revegetation	77–89	5.9–6.8
Lower Little South Fork Elk River (1,200 acres)	Unharvested	0	0
	Harvested, mature	922	77
	Harvested, potentially thinned	50–167	4–14
	Watershed restoration revegetation	71–79	10.1–11.3
Elk River Corridors (400 acres)	Harvested and riparian	400	100
Entire Reserve (7,400 acres)	Unharvested	2,952	40
	Harvested, mature	1,139	15
	Harvested, potentially thinned	846–2,493	11–34
	Watershed restoration revegetation	341–384	4.6–5.2

Note: The distribution of the earlier successional harvested stands that will be potentially subject to thinning is shown in figure 3-4—shrub-sapling harvested, pole harvested, and old-growth harvested stands. BLM proposes to restore from 846 acres (saplings and old-growth harvested only, Alternative 2B) to 2,493 acres (adding pole stands, Alternative 2A) of early seral stage harvested land over a 5-year period. The area treated would be 11–34 % of the entire Reserve. The rate of treatment would be 170–400 acres per year, depending on the selected alternative.

[a] For watershed restoration revegetation, range is from Alternative 1B—Hydrologic Stabilization to Alternative 1A—Full Recontour. For harvested, potentially thinned, range is from Alternative 2B—Low Intensity Forest Restoration to Alternative 2A—Medium Intensity Forest Restoration.

The effectiveness of forest restoration would also differ considerably between the two action alternatives. Under Alternative 2A, up to three thinnings would be made in shrub-sapling stands,

allowing them to be gradually guided to the optimum stand condition for development of old-growth characteristics. Pole stands would also be thinned once. Under Alternative 2B, only one entry would be made in shrub-sapling stands, and they would be left to develop naturally thereafter. Pole stands would not be treated. These differences would affect not only stand structures and tree growth but also the amount of woody debris that would be placed on the forest floor.

Potential Adverse Effects

The single entry approach under Alternative 2B would generate considerable slash requiring disposal, either through pile burning or lopping and scattering the material. Pile burning can damage soils locally, and lopping and scattering creates a short-term fuel accumulation aggravating fire risk. Under Alternative 2A, however, a lesser amount of slash would be generated during each entry (which would be separated by intervals of 10 years), reducing the magnitude of these adverse effects.

The stepped, gradual reduction of canopy cover under Alternative 2A would decrease risk of stand damage caused by windthrow relative to Alternative 2B. However, the felling of poles under Alternative 2A would result in the potential for collateral damage to up to 20% of the remaining trees. The potential for infestation of invasive nonnative species in thinning openings would be greater under Alternative 2A than under Alternative 2B. For reasons described above, these potential impacts are considered less than significant.

The no-action alternative (2C) would result in several adverse effects. The retention of overcrowded second-growth stands and reliance on natural thinning processes implies greater threats of widespread disease or insect infestation, unmanaged buildup of both down fuels and fuel ladders as mortality occurs, and, consequently, increased RSRF (see "Effects on Fire Behavior and Fire Management" below). Because Alternative 2C comprises the impact baseline, this effect is not treated as an adverse impact under CEQA/NEPA, but it is a significant adverse effect relative to the other alternatives.

Effects of Forest Restoration on Special-Status Plants

Special-Status Vascular Plant Species

Forest restoration activities will occur in previously disturbed, harvested stands that have a relatively low probability of supporting special-status plant populations. The prior discussion regarding the effects of watershed restoration on special-status plants is almost entirely relevant here. Survey and avoidance actions would be taken prior to any site activities. Most special-status plant species occur in specialized habitats, such as wetlands, meadows, and other natural forest openings, that are not within the restoration treatment areas, and thinning adjacent to these habitats would be carefully planned on a site-specific basis. Over the long term, the increasing amount of later-successional forest stages will tend to increase the habitat for special-status species. The forest restoration program would have little or no impact on special-status species in the near term and beneficial effects over the long term.

Survey-and-Manage Cryptogam Species

Survey-and-Manage fungi and lichen species have been identified in multiple sites and habitats throughout the Reserve, including in several monitoring plots located in areas proposed for forest restoration. Survey-and-Manage cryptogams are typically associated with old-growth forest types, and the accelerated development of old-growth forest characteristics will result in long-term beneficial effects on habitats for these species. However, ground disturbance, small-tree thinning, and understory fuel treatments may adversely affect local populations of Survey-and-Manage cryptogam species during thinning operations over the next 5–20 years.

These temporary effects are expected to be less than significant because of the nature and scale of the proposed actions. The proposed treatments will retain larger, dominant trees, thereby retaining shaded microclimate conditions in the understory and source populations of cryptogams for recolonizing disturbed areas. During the restoration period, the Reserve will retain a sufficient amount of habitat in untreated condition to ensure that the viability of local cryptogam populations will not be threatened. Fungi populations should not be adversely affected by low-intensity piling and burning (McFarland pers. comm.). In addition, variable-density thinning prescriptions that include retaining untreated clumps of trees within a treatment area, coarse woody debris or duff, and hardwood or shrub species (especially tanoak) in the understory would minimize potential changes to habitat used by these species.

Effects of Forest Restoration on Invasive Nonnative Plants

Forest restoration activities are expected to result in the long-term benefit of controlling invasive nonnative species at the Reserve by accelerating the development of old-growth forest types. When these goals are achieved, the well-shaded habitat created will generally be unsuited to infestation by invasive nonnative species that are currently present in California.

The use of vehicles, equipment, and hand tools to treat forest stands will temporarily disturb soil surfaces and may create conditions favorable for invasive nonnative plant establishment and dispersal in the near term. Use of implementation guidelines in chapter 4 (under “Species Management-Invasive Nonnative Plants” and “Recreation Management”), however, will likely prevent weed propagation, dispersal, and establishment in the restoration sites. If invasive nonnative plants significantly colonize thinning sites, thinning prescriptions would be reconfigured. A program to control invasive nonnative plants will be undertaken at the Reserve to eliminate existing infestations, minimize the introduction of new populations, and eliminate new infestations before they become widespread (chapter 4). Because of the ability to modify prescriptions and the commitment to removal of colonizing plants in the near term, the potential impact of infestations by invasive, nonnative plants caused by forest restoration is considered less than significant.

Effects of Forest Restoration on Water Quality and Aquatic Species

Effects of Management Common to Forest Restoration Action Alternatives

Expected Benefits

Forest restoration would promote the development of old-growth characteristics throughout substantial areas of the Reserve. Because watershed conditions control the physical and chemical conditions of streams that drain the Reserve's watersheds, improvements in forest cover over the long term would improve the suitability of aquatic habitats for fish. As old-growth forest characteristics are restored, natural hydrology and sediment transport processes and rates, as well as cooler stream temperatures, would also be restored. Interception and headwater storage of precipitation would increase, resulting in slowed runoff and increased water clarity, which would provide a more constant release of clearer, cooler water to watercourses throughout the year. Increased canopy would increase shading of stream surfaces. All of these changes would increase aquatic habitat suitability.

Potential Adverse Effects

Short-term increases in surface erosion could result from tree density management. Reduced density would allow more precipitation energy to reach vegetation or soils on the forest floor in the first few years following the action. Density management would not require the use of heavy equipment, with the exception of mobile chipper units, which may be employed on the existing road system. Trees would not be yarded, and no roads or skid trails would be maintained for operational access, except in watershed restoration areas. Accordingly, the amount of soil disturbance from thinning operations is expected to be small.

Slash disposal by lopping and scattering or chipping would tend dissipate precipitation energy and slow runoff, reducing potential soil erosion and sediment delivery to streams. Over the long term, these methods of slash disposal would accelerate the recovery of soil structure damaged by logging. Piling and burning of slash would not provide this mitigation, but may be needed where slash volumes are high. Piling and burning also has the potential to damage soil structure and fertility in spots where burning occurs. Piling and burning would be employed on a limited basis; therefore, the potential for increased sediment yield caused by thinning operations is considered less than significant.

Relative Effects of the Forest Restoration Alternatives

Both the expected benefits and the potential adverse effects of forest restoration on aquatic habitats depend on the intensity and extent of the restoration actions. As previously noted, actions under Alternative 2A could be three times as extensive as under Alternative 2B (table 6-3) and involve multiple entries into some stands but would occur over a longer period of time. However, as discussed above, the potential adverse effects of even the more intensive alternative (2A) would be sufficiently small and generally mitigated on-site such that they would be less than significant. Expected long-term benefits would differ considerably among the alternatives. Alternative 2A would involve accelerated restoration of old-growth canopy and favorable storage/runoff conditions over a much larger area of the Reserve.

Under the no-action alternative (2C), recovery of natural hydrologic processes benefiting forest aquatic and riparian habitats would be expected to take substantially longer than would occur under either Alternative 2A or 2B. Alternative 2C also poses the possibility that watershed conditions could be severely damaged by a stand-replacing fire (see "Effects of Forest Restoration on Fire Behavior and Fire Management" below). The resulting loss of cover and soil damage would result in increased soil erosion, alteration of the natural hydrograph, and increased water temperatures, all of which can greatly degrade the suitability of aquatic and riparian habitats for fish and other organisms.

Effects of Forest Restoration on Wildlife

Effects of Management Common to Forest Restoration Action Alternatives

Expected Benefits

Long-term beneficial effects on special-status and common wildlife would result from forest restoration that enhances old-growth forest ecosystems in the Reserve. Preservation and enlargement of the Reserve's patch of old-growth forest will provide critical habitat for species uniquely dependent on this type of diminishing habitat. Early-successional, disturbed habitat is widespread in the region, so conversion of the Reserve's harvested lands to preharvest condition diminishes an abundant habitat (early-successional redwood forest) in favor of a limited one (late-successional redwood forest). From a landscape perspective, the relative value to regional wildlife of the habitat created far exceeds that of the habitat lost. In particular, forest restoration would accelerate the expansion of habitat that is critical to the survival of the threatened marbled murrelet and northern spotted owl.

Potential Adverse Effects

Forest restoration activities could result in loss of successional habitat and short-term disturbance to forest and shrub habitat for common species and noise disturbance to breeding birds in treatment areas, adjoining mature harvested stands, or old-growth groves. However, breeding-period closures and other implementation measures described in chapter 4 would prevent any breeding disturbance to species identified as threatened, endangered, candidate, sensitive, or otherwise special-status.

Effects on various wildlife species or species groups are as follows.

Effects on Common Wildlife

The long-term benefit of forest restoration to common wildlife would be an acceleration of forest succession to old-growth habitat in previously harvested areas throughout the Reserve. Common wildlife species that depend on old-growth forest would benefit from the accelerated increase in available suitable habitat over time.

Pole and shrub habitats that currently exist in the Reserve would be significantly altered by the restoration actions. Brush would be removed, saplings and pole-stage trees would be thinned, and slash would be scattered on the forest floor (or in some cases, pile burned) over perhaps 200 acres per year for up to 20 years. These actions would result in direct disturbance to common

species and may cause direct mortality in some cases. The long-term effect on common wildlife would be a reduction in the amount of habitat available to species adapted to early-successional forest habitats. Because these species are locally and regionally abundant and widely distributed, the adverse effect on these species is considered less than significant.

Another short-term impact of forest restoration is the potential for noise to interrupt normal breeding behavior of common birds. Limited operating periods established for federally listed birds, together with mitigation measures established for migratory birds (discussed below), will prevent significant disturbance to breeding common birds.

Effects on Migratory Birds

As with common wildlife species, the long-term indirect effect of forest restoration will be the reduction in the amount of suitable habitat for migratory bird species adapted to edges and disturbed areas, such as American robins and dark-eyed juncos. Because these species are considered locally and regionally abundant and widely distributed, reduction in the amount of available, suitable habitat will not threaten to reduce or eliminate populations.

An estimated 60% of the restoration activities will be restricted to limited operating periods established for nesting marbled murrelets and northern spotted owls (figures 3-6 and 3-7). There may be a small amount of unquantified, unintentional take of migratory bird species.

Effects on Marbled Murrelet and Northern Spotted Owl

Forest restoration would directly benefit marbled murrelet and northern spotted owl. Acceleration of succession of shrublands and young forest stands to old-growth forest will accelerate development of new habitat required by these species. The restoration and enhancement of late-successional old-growth habitat, at the Reserve in particular, is a key component of the recovery plan for both the northern spotted owl and marbled murrelet populations in the region (U.S. Fish and Wildlife Service 1997). When thinned stands begin to reach maturity, the reduction in the amount of suitable habitat available to edge-tolerant corvids will also indirectly benefit these special-status birds.

Existing marbled murrelet and northern spotted owl habitat will not be removed or degraded as a result of the proposed activities. Noise disturbance from restoration activities has the potential to interrupt the normal breeding behavior of marbled murrelets and northern spotted owls in later successional stands near treatment areas. Forest restoration actions that may cause visual or auditory disturbances that are not adequately dampened by vegetative or topographic screening will be restricted by distance buffers of up to 0.25 mile from occupied or suitable habitat of marbled murrelets or northern spotted owls. If buffers cannot be used effectively, limited operating periods will be imposed (September 15–March 23 for murrelet habitat and August 1–January 31 for northern spotted owls).

Effects on Bald Eagle and Osprey

Restoration of old-growth forests in the Reserve will not benefit these species because suitable nesting habitat requires the presence of large water bodies (i.e., lakes, reservoirs, rivers) near the nest locations.

Bald eagle or osprey nesting or roosting habitat will not be affected by the proposed restoration activities in shrub-sapling and pole stands. Because eagles have not been using the Reserve for nesting and are mobile, the potential for noise to disturb the species is minor. If, however, a bald eagle or osprey nest were located in the Reserve before restoration activities were begun or completed, appropriate avoidance measures would be implemented until the young had fledged.

Effects on Amphibians and Reptiles

Restoration of forest ecosystems will benefit terrestrial amphibians over the long term because development of dense canopy cover will be accelerated, which will, in general, produce a moister microclimate on the forest floor. This change will tend to expand and improve the quality of suitable habitat for species such as clouded salamander, black salamander, California slender salamander, and ensatina. Reptiles will not benefit from enhancement of old-growth habitat because they generally require open, sunny areas for basking.

Restoration activities in or adjacent to habitats that support these species have the potential to disturb or harm individual animals. However, habitat for these animals tends to be in riparian and aquatic zones, which are generally excluded from thinning treatments. Alteration of ground level riparian zones by thinning in adjacent stands could temporarily degrade habitat conditions locally. Avoidance measures (chapter 4) will be implemented to preclude these impacts.

Survey-and-Manage Wildlife Species

Enhancement of old-growth habitat and maintenance of a canopy cover near riparian areas will benefit the Del Norte salamander. Because of greater canopy density over time, restoration activities will produce a moister microclimate, enlarging the extent of suitable habitat for this species.

Forest restoration activities would generally not affect suitable habitat for the Del Norte salamander.

Relative Effects of Forest Restoration Activities

Both the expected benefits and the potential adverse effects of forest restoration on wildlife and wildlife habitat depend on the intensity and extent of the restoration actions. As previously noted, actions under Alternative 2A could be three times as extensive as under Alternative 2B (table 6-3) and involve multiple entries into some stands but occur over a longer period of time. However, the potential adverse effects of even the more intensive alternative (2A) would be small or avoided by seasonal closures and predisturbance surveys and avoidance actions where needed. None of the temporary disturbance would threaten to eliminate a species population or significantly reduce the range of species. The impact to wildlife under both action alternatives would be less than significant.

Expected long-term benefits, however, would differ considerably among the alternatives. Alternative 2A would involve accelerated restoration of old-growth canopy and favorable storage/runoff conditions over a much larger area of the Reserve.

Under the no-action alternative (2C), recovery of old-growth characteristics would be expected to take substantially longer than would occur under either Alternatives 2A or 2B. Alternative 2C

also poses the possibility that existing habitats could be severely damaged by a stand-replacing fire (see following section).

Effects of Forest Restoration on Fire Behavior and Fire Management

Effects of Management Common to Forest Restoration Action Alternatives

Expected Benefits

In addition to accelerating the recovery of old-growth characteristics, stand density management would reduce the RSRF. By avoiding losses to fire, this effect would help accelerate the recovery of old-growth characteristics in earlier-successional stands, help to protect adjoining old-growth groves, and reduce risks to adjoining lands. Unthinned pole stands pose the highest RSRF, followed by shrub-sapling stands. Later-successional stands have correspondingly lower RSRF (table 3-9). Removal of the material from the canopy structure and subsequent treatment of the slash would result in lower crown bulk densities, increased average crown base heights, decreased flammable litter layer depths, and discontinuities in both vertical and horizontal fuel structures. If fire ignited one of these stands, flame lengths would be relatively decreased and crown base heights would be relatively higher, greatly reducing the potential for crown fires, whole-stand mortality, and rapid spread into adjoining stands.

Potential Adverse Effects

Proper treatment of slash is required to avoid a potential adverse effect of increased fuel load on the forest floor in the dry seasons following thinning treatments. In dense pole stands, relatively large amounts of slash are created by thinning. In the Reserve, wherever possible, slash will be lopped and scattered or chipped to decompose rapidly in the warm, wet climate. Pile burning may be employed under some circumstances (e.g., drier slopes) where the other methods are infeasible. If average tree spacing in thinned stands is less than 20 feet, slash to be burned will be moved out of the stand or into an opening created under the variable-density thinning approach, to avoid initiating a crown fire in the thinned stand. The proposed slash treatment program will preclude a significant short-term increase in RSRF under the action alternatives.

Forest thinning and slash disposal activities pose the risk of fire ignition caused by exhaust sparks emitted from hand-held and heavy equipment and/or sparks caused by the striking of chainsaw blades on rocks. This adverse effect would be temporary and would be minimized by requiring fire-awareness training of field personnel.

Relative Effects of the Forest Restoration Alternatives

Both of the action alternatives (2A and 2B) would provide the benefits of decreased RSRF, but the benefit afforded by alternative 2A would be much greater. Alternative 2A involves thinning in the highly hazardous pole stands, as well as in the moderately hazardous shrub-sapling stands. Moreover, repeated thinnings in shrub-sapling stands under Alternative 2A would allow for better control of stand flammability as the treated stands developed. As noted in chapter 3, the greatest risk to the primary old-growth grove at the Reserve is the intrusion of a pole harvested stand on a

southwest-facing slope above Salmon Creek. Being a pole stand, it would not be treated under Alternative 2B.

Under Alternative 2C, existing levels of RSRF would increase as the extensive shrub-sapling stands developed into pole stands, and as existing pole stands remained crowded with suppressed growth rates for several decades. Increased RSRF in these stands would represent a significantly increased threat to old-growth groves occupying the ridge tops above these stands. This increased threat is a significant adverse effect of the no-action alternative (2C).

RSRF has two elements: ignition and initial spread, and postignition behavior. Ignition and initial spread is related to public access and is analyzed in the following section. Postignition behavior is most directly related to stand structure and slope position (table 3-9). Differences between the alternatives can therefore be characterized by treated acreages in various risk (RSRF) classes, defined on the basis of seral stage and slope position. As shown on table 6-4, Alternative 2B would treat 1,080 acres, of which 442 acres have high RSRF. Alternative 2A, by including treatment of pole stands, would also treat another 314 acres having high RSRF and 1,363 acres having extreme RSRF. Once treated, these stands would have a low or low-moderate RSRF.

Table 6-4. Risk of Stand-Replacing Fire (RSRF) of Stands to Be Treated under the Forest Restoration Alternatives

Forest Restoration Alternative	Extent of Treated Stands (acres)								
	Shrub/Sapling Harvested		Pole Harvested		Mature Harvested		Seed Tree Harvested		
	L 1/3	U 2/3	L 1/3	U 2/3	L 1/3	U 2/3	L 1/3	U 2/3	Total
2C	0	0	0	0	0	0	0	0	
2B	205	442	0	0	0	0	236	197	1,080
2A	205	442	314	1,363	0	0	236	197	2,757
Risk of stand-replacing fire	M	H	H	E	L–M	M–H	L–M	M	

Notes: L1/3 = lower 1/3 slope position.
U2/3 = upper 2/3 slope position.
E = extreme risk.
H = high risk.
M = moderate risk.
L = low risk.

Interdependent Effects of Forest Restoration Alternatives and Public Access Alternatives

The current ignition hazard at the Reserve could be significantly affected by the combined changes in stand flammability (RSRF) and changes in public access to the Reserve. Assuming that risk is increased by human contact with flammable vegetation, changes in this hazard depend primarily on the forest restoration and trail-access alternatives selected. Table 6-5 shows lengths of trail passing through vegetation in various risk classes, based on seral stage and slope position, for each combination of forest restoration and trail-access alternatives. The table captures two counter effects: increased risk caused by more extensive trail systems in some alternatives and decreased risk caused by the various forest restoration alternatives.

Relative to the no-action condition (Alternatives 2C and 4D), the table indicates that the two more extensive trail system alternatives (4A and 4B) would increase present contact between visitors

and the higher RSRF stands (extreme, high, and medium-high) 3.2– 4.6 fold, for alternatives 4B and 4A, respectively. The data in the last column also indicate the relative effectiveness of the two forest restoration alternatives in countering the increased contact. Both alternatives would reduce the contact significantly, but the reduction is most substantial for the most extensive trail system alternative. Considering the high and extreme RSRF categories only, the data indicate that at least one of the forest restoration alternatives must be implemented to prevent an increase in the highest risks associated with the preferred or extensive trail system alternatives. Also apparent is the fact that public contact with high and extreme RSRF stands would only be precluded by selection of the most intense forest restoration alternative (2A) or by substantially limiting access, as under trail system Alternative 4C, which confines visitation to the Elk River corridor.

Effects of Forest Restoration on Recreation Activities

Effects of Management Common to All Forest Restoration Alternatives

Accelerated restoration of old-growth ecosystems would enhance recreation opportunities over the long term by expanding this diminishing habitat and increasing populations of fish and wildlife that depend on old-growth systems. Appropriate public access to this enlarging resource would continue to be made available over the long term.

Potential adverse effects of forest restoration on visitation include temporary noise (from chainsaws and chippers), dust, motor emissions, and, in some cases, smoke. Temporary trail closures for visitor safety and to provide visitor protection from these emissions will temporarily reduce visitors' access opportunities. In sensitive areas that are highly visible to the public, a visual resource analysis will be conducted to determine impacts and appropriate mitigation measures to protect scenic values. Moreover, visual changes, including reduced canopy and increased material on the forest floor, may be considered adverse by some visitors (although some visitors may consider thinning of pole stands to be a visual improvement). Because of the temporary nature of these disturbances and changes and the limited annual period during which they can occur (to protect nesting murrelets and owls), these adverse effects are considered less than significant.

Relative Effects of the Forest Restoration Alternatives

Under Alternative 2A, the visual appearance of stumps of pole-sized trees may also be considered objectionable by some users.

Effects of Forest Restoration on Cultural Resources

Forest restoration activities are generally not land-disturbing and therefore have little potential for disturbing undiscovered cultural resources. Nonetheless, before forest restoration projects are implemented, work areas will be surveyed for cultural resources, and, if any are encountered, the project will be modified based on an evaluation by a qualified archaeologist. If any cultural materials or sites are encountered during forest-thinning activities, all work will be stopped until a qualified archaeologist has evaluated the find. Accordingly, potential direct impacts on cultural resources are considered less than significant. No potential indirect impacts have been identified.

Research Management

Effects of Research Management on Research Activities

Goals, direction, and implementation guidelines established in chapter 4 for management of research will ensure that a wide range of research is carried out at the Reserve. The research permit process will help people writing proposals assess the relevance of their work to long-term management of the Reserve and adjust their proposal protocols to minimize adverse effects to the Reserve's ecosystems. Basic research that may have no apparent or direct application to management of the Reserve will not be excluded, however. BLM and DFG recognize the need for research into basic ecosystem process, structure, and function and that unharvested areas of the Reserve where natural conditions are relatively intact can serve as a baseline. Thus, research management is expected to encourage both applied and pure research and to improve the quality or diminish unnecessary adverse effects of such research.

Effects of Research Management on Biological Resources

As described in chapter 4, research proposals will be screened and modified as necessary to ensure that no significant harm to the Reserve's biological resources will result from research conducted in the Reserve. For example, research into life stages of threatened species using the Reserve will not be allowed if a potential exists for the research field activities to

- diminish species numbers,
- interrupt or significantly disturb reproductive or other species activity, or
- otherwise diminish the prognosis for species sustenance at the Reserve or in other affected areas.

Because of the long distance to the central (old-growth) portion of the Reserve, some researchers may request that field personnel be allowed to use motorized trail vehicles for a easier access or to occupy the Reserve on an overnight basis. Such proposals will be evaluated on a case-by-case basis, according to evaluation criteria in chapter 4. Motorized access would be considered only for the Elk River corridor, and would be granted only if the alternative to overnight occupancy would entail greater potential adverse effect on the Reserve's ecosystems. Overnight occupancy, where it is approved, would be subject to the implementation guidelines in chapter 4, which are intended to eliminate the possibility that corvid intrusion will be encouraged by the occupancy. No such occupancy would be permitted within ¼ mile of old-growth groves or within 150 feet of streams.

Considering the proposed provisions of the research management program, potential impacts on biological resources are considered less than significant.

Effects of Research Management on Resource Monitoring

Some of the research that will be approved in the Reserve is expected to contribute resource monitoring data that are needed to assess the effects of plan implementation (table 4-7). Researchers will be encouraged to modify research proposals to provide such information, where

it is consistent with the intended research, and to share results of research with BLM managers. Thus, research management may provide a benefit to the needed resource monitoring program.

Fire Management

Aspects of fire management involving fuel hazards and public access affecting potential ignition of fire were discussed in "Effects of Forest Restoration on Fire Behavior and Fire Management" above. Accordingly, this section focuses only on fire suppression.

Effects of Fire Suppression on Fire Frequency and Behavior

As described in chapter 4, most fire originating or entering second-growth forests would be met with a full-suppression response using a minimum-impact strategy. Fire in old-growth stands may or may not be allowed to continue burning, based on a site-specific, weather-specific assessment.

Unlike many forests in the drier interior, coastal redwood forests of California are not considered fire-dependent forests that rely on a high fire frequency for regeneration or sustenance of forest ecosystem processes. The natural fire frequency in the region is on the order of hundreds of years (chapter 3); therefore, fire is not a major determinant of ecosystem structure, process, or function. Accordingly, full suppression of fire would not be expected to result in changes in species dominance (e.g., increasing dominance by shade-tolerant species) or cause significant changes to forest structure or function that would increase fire frequency or intensity in the future. The Reserve's forests are not subject to the phenomena plaguing management of pine forests throughout the western United States, where fire suppression has increased the potential for fire damage over the long term.

The case-by-case decision to allow or suppress fire in old-growth groves would also have relatively little bearing on future fire frequency and behavior in these stands. Allowing fire to burn when prescriptive conditions are met may prevent or reduce damage from future fires that burn when prescriptive conditions are not met.

Effects of Fire Suppression on Biological Resources

Fire suppression activities in second-growth forest in harvested areas may temporarily degrade biological resources, but absence of suppression would likely cause catastrophic degradation of these resources (see discussion of the relative RSRF of the various seral stages under "Fire Regime and Hazard" in chapter 3).

Suppression may include the construction of fire lines by hand or by dozer. The use of dozers would be confined to ridge tops in harvested portions of the Reserve to the extent possible, but dozers could be required in other harvested areas as well. Full rehabilitation of dozer lines would be required after fire suppression is completed. Rehabilitation would involve recontouring soil surfaces to their natural topography, placing removed vegetation over the finished soils as a mulch, and planting native trees and shrubs if natural colonization is expected to be slow.

The temporary ground-disturbing effects of fire suppression, mitigated to a substantial degree by line rehabilitation, is insignificant compared to the severe effects of the fires being suppressed. The fire suppression impact is considered less than significant.

Noise disturbance to nesting birds (e.g., marbled murrelet and spotted owl) may result from fire suppression activities in nearby second-growth forests. The effect would be relatively small compared to the disturbance posed by the fire itself. Given this small effect and the relative infrequency of fire, this potential adverse effect is also considered less than significant.

Effects of Fire Suppression on Research

Fire suppression in old-growth groves, if any is required, may diminish the value of these stands in the Reserve as a natural biological baseline. This potential adverse effect, because it is expected to occur so infrequently, is not considered significant.

Effects of Fire Suppression on Recreation

Fire and fire suppression would probably require closure of some or all of the Reserve during the suppression activities. Such events are expected to be very infrequent and of short duration; therefore, the adverse effect on recreation is considered less than significant.

Visual Resource Management

Because of the legislative direction and various management goals for the Reserve, none of the alternatives include plans for actions that would have long-term negative impacts on visual qualities. Some road restoration projects will have detrimental effects on visual quality in the short term because the temporary removal of vegetation will cause color contrasts. Forest restoration and trail construction activities will also result in temporary visual contrasts of color and texture compared with the natural landscape. However, implementation of any of the alternatives will greatly improve the Reserve's visual qualities in the long term. By removing road networks and accelerating changes in forest to an old-growth composition, the contrasts from recent human activities will be reduced and the area will revert to a naturally appearing landscape. Within 25 years, almost all of the 2,750 acres that fall under VRM Class 3 (see appendix E) will be improved so that they can fall into the Class 2 category, where the appearance of the landscape is more natural. The only area of the Reserve remaining in a Class 3 zone would be the first three miles of the Elk River corridor. None of these effects are significantly adverse.

Recreation Management

Effects of Recreation Management on Visitor Experiences

Effects of Management Common to All Recreation Alternatives

All alternatives provide sufficient public access to the Reserve. The Elk River Trail extends nearly three miles into the Reserve with a gentle gradient adjacent to the riparian woodland along the South Fork Elk River. It would remain open and maintained all year under all alternatives. Along the trail corridor, spur or loop trails would lead to a self-guided nature walk, interpretive sites of historical properties, contact with the river, and picnic-table sites. A pavilion for recreation tours and group activities would be constructed a short walk from the trailhead. Three of four trail alternatives are formulated to also allow contact with old-growth ecosystems. Restrooms and gravel parking areas will be provided at all trailheads.

A multifaceted recreation program, both off- and on-site would be conducted to enhance public understanding of the Reserve's resources and threats to its ecological integrity. Guided walks by naturalist rangers would be conducted regularly during the summer season. Interpretive kiosks will be installed at all trailheads. Development of a visitor center in the vicinity of the Reserve will be explored. This recreation program will result in high-quality visitation experiences.

All lands within the Reserve will be managed according to direction for BLM's various visitor management zones and visual resource management classes (appendices E and F). These guidelines will help to minimize the impacts of visitation on the Reserve's ecological integrity and will not adversely affect visitor opportunities.

All visitor access will be confined to designated trails. This restriction may displease those visitors who would like to explore the Reserve by cross-country hiking. This dissatisfaction would be reduced by the two alternatives that allow some entry into old-growth groves.

Seasonal and hourly restrictions on trail use to protect nesting marbled murrelet and northern spotted owl and to protect trails from water damage will disappoint some visitors at certain times of the year. This effect can be largely diminished by continuing to widely publicize these restrictions.

Fishing, hunting, trapping, camping (except for Alternative 4A), and motorized vehicle use will continue to be prohibited in the Reserve. Equestrian and mountain biking uses may also continue to be prohibited (depending on alternatives selected). Recreationists seeking these types of activities will have to rely on other recreation opportunities elsewhere in the region. As these uses were not available within the Reserve prior to acquisition, any decisions to not allow these uses would not decrease the availability of these opportunities within the region.

Relative Effects of the Recreation Alternatives

Alternatives for Availability of Southern Access

Alternative 3A would allow access to the Salmon Pass Trailhead via Newburg and Felt Springs Roads by individual vehicles at times during daylight hours of open seasons when the Felt Springs Road gate is unlocked. This alternative would allow unescorted visitor use of Reserve trails reached by the southern access route. This alternative would benefit some visitors by

allowing independent exploration of the Reserve's ecosystem. However, visitors would also lack the benefit of guided, interpretive hikes such as those provided under Alternative 3B. A means of mitigating this deprivation would be to grant permission for unescorted use by permit at the close of a BLM guided tour.

Alternative 3B, continuation of interim management, would entail BLM providing guided, interpretive hikes in lieu of individual exploration. Access to the Salmon Pass Trailhead and associated trails would be restricted to scheduled, guided interpretive hikes involving BLM-organized vehicle convoys or shuttle service. Visitors would be required to remain with the tour group. This controlled type of access would provide a less autonomous visitation experience than under Alternative 3A, but guided access to the Reserve would be conducted throughout the entire trail system selected.

Alternative 3C would eliminate the southern access and thereby allow public access only to the Elk River Trailhead on the north side of the Reserve. This alternative would require visitors who are seeking to experience old-growth forests to undertake an arduous hike. From the Elk River Trailhead, access to old-growth groves requires a 11.2-mile round-trip day hike, whereas from the Salmon-Alicia Pass area, an old-growth grove could be reached by a short walk (although a 2.6-mile round-trip hike on the Salmon Pass Trail is now required).

Relative to existing management of the southern access (Alternative 3B), only Alternative 3C would adversely affect the quality or type of visitor experience of the Reserve. This alternative would eliminate the potential opportunity (otherwise provided by Alternatives 4a and 4b) for elderly and disabled persons to experience the Reserve's old-growth ecosystems, the resource that compelled public acquisition of these lands.

Alternatives for Extent of Trail System

Various trail system alternatives were described in chapter 5 (figure 5-1, tables 5-1 and 5-2). Each of four alternatives would provide a different level of contact with old-growth ecosystems.

Alternative 4A would provide extensive opportunities for old-growth contact. Northern access routes would include a reconstructed Elk River Corridor Trail and a relocated Little South Fork Elk River Trail with a terminal loop through the northern old-growth grove. Southern access routes would include the existing Salmon Creek Trail, new Salmon Creek Spur Trail and Salmon Creek Loop Trails (2), Universal Access Trail, and the Alicia Pass Loop Trail, each of which would provide contact with old-growth. Additionally, the Western Periphery Trail and Historic Military Ridge Trail would connect the northern and southern portions of the Reserve and pass through the central old-growth groves, the latter for 2.4 miles. Such a trail system would offer the general public, as well as elderly and disabled visitors, a full range of opportunities to experience old-growth ecosystems. The Alicia Pass Loop and Universal Access Trail (wheelchair accessible) would offer short walks with gentle gradients for convenient entry into the southern old-growth grove. In contrast, the Historic Military Ridge Trail, reached by a long, arduous hike, would allow the visitor extended contact (2.4 miles) within the heart of the main old-growth grove.

Alternative 4B would also provide old-growth contact but less so. The Universal Access Trail and the relocated Little South Fork Elk River Trail would allow walking and hiking in old-growth groves—the first entailing an easy stroll, the second requiring an arduous hike. This alternative would exclude the Alicia Pass Loop Trail and the two north-south connecting trails and therefore provides less diversity and intensity of old-growth experience. Old-growth edge contact and

close viewing would continue to be available from the existing Salmon Creek Trail and from the new Salmon Creek Trail Loops and Spur. This alternative therefore provides access to old-growth groves for elderly and disabled visitors. Access is less extensive for other members of the public.

Alternative 4C, while allowing trail access to the South Fork Elk River riparian zone of the Reserve, would prevent access to old-growth groves to maximize protection of ecosystem integrity. This alternative would displease those visitors seeking to experience the old-growth forests of the Reserve. As noted previously, a robust recreation program would nevertheless be conducted in the Reserve, focused on the riparian, historical, and aesthetic resources of the Elk River corridor.

Alternative 4D would continue existing access conditions, which permit close viewing of old-growth from the north (via the Elk River Corridor Trail and the existing Little South Fork Elk River Trail) and edge contact and near viewing of old-growth from the south (Salmon Creek Trail). An arduous hike of 11.2 miles (round-trip) from the Elk River Trailhead or a shorter hike of at least 2.6 miles (round-trip), both involving steep sections of trail, would be required to achieve these old-growth experiences. Thus, this alternative does not provide opportunities for the elderly and disabled, who may require shorter hikes or wheelchair access with gentle gradients. This alternative represents no change from existing conditions.

Relative to the existing extent of the trail system (Alternative 4D), only Alternative 4C poses a significant impact to the quality or type of visitor experience of the Reserve. This alternative would eliminate the public's opportunity to experience to some degree the old-growth ecosystems for which the Reserve property was acquired.

Alternatives for Bicycle Use

Regional Mountain Biking Opportunities

As described in chapter 3, numerous recreation opportunities exist for mountain bicyclists in Humboldt County and in the Humboldt Bay region (figure 3-9), and several recreation sites have unused capacity for this activity (table 3-11). The extent of trails on inventoried sites ranges from 7 to approximately 45 miles, with a combined total of approximately 100 miles. The quality of trails ranges from moderate to high, and the level of challenge ranges from easy to difficult. Environments accessed include both forest and coastal plain. Managers of some sites have plans to increase capacity to keep abreast of demand (i.e., Redwood National/State Parks, Humboldt Redwoods State Park, and Arcata City Forest).

Potential Adverse Effects of Mountain Biking on Visitor Experiences

Mountain biking is an outdoor activity that emphasizes exercise and, on downhill trail segments, speed. It involves relatively rapid passage through surroundings and, as such, is generally less compatible with the emphasis at the Reserve on the more contemplative activities of interpretation and education about natural and cultural resources.

Alternatives Comparison

Two alternatives for introducing bicycle use into certain areas of the Reserve were formulated. More widespread use of bicycles was initially considered but rejected for the majority of the existing or potential trails where gradients are steep and widths narrow (appendix J).

Alternative 5A would accommodate cycling on widened trails or on former roads having greater width, to reduce recreation user conflicts. These trails would include the Elk River Corridor

Trail, the Salmon Creek Trail, and the new Little South Fork Elk River Trail. This alternative would benefit cyclists by allowing maximum cycling opportunities in the Reserve (4.8 miles) but would present a potential adverse effect on hikers and equestrians by increasing the risk of collision or panic response, especially on the steeper Salmon Creek Trail and new Little South Fork Elk River Trail. It would also present the potential to disrupt other recreation tours or individual contemplation in the Reserve.

Alternative 5B would accommodate cycling only on the Elk River Corridor Trail (2.9 miles, or 5.8 miles round trip). This alternative would provide less benefit than Alternative 5A to cyclists by not providing any cycling from the southern access. Accordingly, it would eliminate the potential for conflicts with other users along the Salmon Creek Trail and new Little South Fork Elk River Trail.

Alternative 5C would not accommodate bicycle use in the Reserve, continuing current management. Cyclists living in the Humboldt Bay region would need to continue relying on other recreation opportunities in the region (table 3-11), which are available to absorb increased use. Although this alternative would provide no benefit to cyclists, it would eliminate the potential for conflicts with other users and the need to develop minimal facilities.

Conclusion

As discussed, alternatives introducing bicycle use into the Reserve (5A and 5B) would create a collision hazard and other conflicts with equestrians and hikers, and would detract from the interpretive/educational focus of recreation management at the Reserve. This adverse effect is potentially significant. It may be partially mitigated by selecting Alternative 5B rather than 5A and by limiting bicycle use to certain days of the week.

Alternatives for Equestrian Use

Regional Equestrian Opportunities

As described in chapter 3, numerous recreation opportunities exist for equestrians in Humboldt County and in the Humboldt Bay region (figure 3-9), and several recreation sites have unused capacity for this activity (table 3-11). The extent of trails on inventoried sites ranges from 3 to 50 miles, with a combined total of more than 130 miles. Adequate parking for horse trailers and loading activities have been developed at these sites, and six of the seven sites have direct trail access from off-site locations. The quality of trails ranges from moderate to high, but some sites do not have adequate stock-water facilities. Environments accessed include both forest and coastal plain. Managers of some sites have plans to increase capacity to keep abreast of demand (i.e., Redwood National/State Parks, Humboldt Redwoods State Park, and Arcata City Forest).

Potential Adverse Effects of Equestrian Use on Visitors' Experiences

Equestrian activity on trails in the Reserve would be consistent with the interpretive/educational focus of recreation management at the Reserve and would not pose a safety hazard to other users. However, conflicts between hikers and equestrians do exist. Recreation users may find the littering of trails with horse excrement to be unpleasant. Complaints commonly cite excrement odor, difficulty in walking without excrement contact, increased populations of annoying flies, and dusty and unstable trail surfaces.

Equestrian use would require that trails open for use be constructed and/or maintained to a wide-trail standard, allowing users moving in opposite directions to pass one another. Trail widths would need to be about twice as wide as for hiking-only trails, and total width considering cut and fill slopes would be correspondingly larger. Watering sources, isolated from natural waters,

would need to be developed at appropriate intervals (every 12 miles) along the trails. Trailhead parking would need to be enlarged to accommodate parking of trailers and stock loading activities. Accordingly, minimal facilities necessary to provide public access to the Reserve would need to be constructed or maintained to accommodate equestrian use.

Alternatives Comparison

Two alternatives for introducing equestrian use into certain areas of the Reserve were formulated. More widespread equestrian use was initially considered but rejected because expanded parking facilities at southern access trailheads cannot feasibly be developed (appendix J).

Alternative 6A would accommodate horseback riding on the Elk River Corridor Trail and Little South Fork Elk River Trail. This alternative would benefit equestrians by providing an opportunity for a long ride (10–11 miles round-trip), which allows access to both riparian and old-growth habitats. Potential adverse effects include a greater extent of annoyance caused by horse excrement and trail wear and minimal facilities development.

Alternative 6B would accommodate equestrian use only on the Elk River Corridor Trail, providing equestrians with a shorter ride (5.8 miles round-trip) in riparian habitats. No access to old-growth groves would be provided. Horse excrement and trail wear issues and minimal facilities development would be limited to the Elk River corridor.

Alternative 6C would not accommodate horseback riding in the Reserve, continuing current management. Equestrians living in the Humboldt Bay region would need to continue relying on other recreation opportunities in the region (table 3-11), which are available to absorb increased use. This alternative would provide no benefit to equestrians but would avoid excrement and trail condition issues with other users and the need to develop more than minimal facilities.

Conclusion

As discussed, alternatives introducing equestrian use into the Reserve (6A and 6B) would cause annoyance to hikers due to horse excrement, dusty and rough trail surfaces, and the necessity to stop or move aside for horses to pass. These adverse effects would be considered significant to some users and not to others. They may be slightly mitigated by selecting alternative 6B rather than 6A and by limiting equestrian use to certain days of the week. Equestrian use would also involve constructing minimal facilities necessary to provide public access to the Reserve, contrary to legislative direction for Reserve management (chapter 2). The effect is considered to be significant.

Effects of Recreation on Special-Status Plants

Human access into the Reserve may directly affect special-status plant species, including Survey-and-Manage cryptogams, because of new trail construction, trampling, or unauthorized collecting if trails are situated within or adjacent to special-status plant populations. Predesign surveys will determine if any special-status plant populations occur within new trail alignment corridors. If occurrences are found, new trails will be sited away from such populations. Prohibitions on off-trail hiking and plant collecting will minimize the potential for damage to or loss of such plants. These measures reduce the potential for adverse effects on special-status plant populations to less than significant.

Effects of Recreation on Invasive Nonnative Species

New populations of invasive nonnative species may colonize the Reserve due primarily to two aspects of recreation. First, the construction of new trails would remove both surface and brush canopy vegetation, exposing disturbed soils to possible germination and increasing sunlight, which favors invasives requiring full sunlight, such as pampas grass. The potential for this effect corresponds to the trail lengths of the various trail system alternatives (4A–4D), which are shown in tables 5-1 and 5-2, and the widths of trails constructed, which depend on whether equestrian uses are accommodated (Alternatives 5A, 5B, 6A, and 6B). Wider trails, rather than longer trails, pose the greatest potential for infestation because of the sunlight openings that wider trails create.

Second, the introduction of equestrian uses could promote the introduction of seed into the Reserve via horse excrement, hide, hooves, or trailer bedding. Yellow star thistle is not likely to be introduced by horse excrement because plants are inedible when the seeds are developed. Plants of most concern would be nonnative annual grasses, such as ripgut brome and quaking grass. This potential would be minimized by use of implementation guidelines described in chapter 4 for preventing the spread of noxious weeds and pathogens by equestrians.

Reserve managers are presently inventorying and mapping invasive nonnative species populations in the Reserve and prioritizing eradication efforts. The prioritization of eradication actions in areas likely to be used by equestrians or where infestation along new or existing trail openings is possible will minimize the potential for the spread or establishment of new populations.

Based on the current levels of infestation in the Reserve and measures to be taken to prevent new or eliminate existing infestation, the potential for the spread of invasive nonnative species caused by various recreation alternatives is currently considered less than significant. However, this conclusion should be reconsidered at least every five years, based on results of monitoring these species (table 4-7).

Effects of Recreation Management on Aquatic Ecosystems

Effects of Management Common to All Recreation Alternatives

Aquatic habitats or fish would not directly benefit from public access to the Reserve. However, indirect benefits to the aquatic resource could result from increased public awareness of the unique forest resources of the Reserve as a result of interpretive walks and school and community outreach programs.

Because flowing water tends to attract and concentrate visitors, streams in the Reserve are likely to be adversely affected by public use. Clark and Gibbons (1991) report that recreation use can affect steelhead and salmon habitat in the following ways:

- riparian vegetation disturbances can influence erosion, cover, food sources, and water quality;
- instream disturbances can affect stream morphology, water quality, streamflow, substrate, and debris; and
- upland disturbances in soils and vegetation can affect runoff and erosion.

In the Reserve in particular, continued or increased public access could result in increased:

- destruction of riparian cover along South Fork Elk River and perhaps other streams,
- soil erosion and sedimentation of aquatic habitats caused by trail erosion,
- soil erosion and sedimentation caused by off-trail and streambank activities,
- water contamination with human or animal wastes or soaps, and
- direct disturbance of spawning fish.

Regulations imposed under all alternatives and posted at trailheads would prohibit cutting or destroying vegetation, digging soils, hiking off-trail, disposing human waste improperly, discharging soaps or other pollutants to streams, allowing horse contact with natural waters (for equestrian alternatives), fishing, and disturbing aquatic organisms. Though these regulations will be effective in reducing incidences of these types of impacts, some impact to aquatic habitat quality must be anticipated. Impacts will depend on the *extensiveness* of human contact with streams and the *intensity* of contact in particular areas. Because of the intensity of use along the Elk River Corridor Trail, most of the impacts of public access on aquatic habitats will occur in the Elk River corridor portion of the Reserve.

Although the potential exists for the types of adverse effects listed above on fish and aquatic habitats, it is likely that they can be controlled in the Elk River corridor through law enforcement efforts. Under alternatives that allow extensive public access, however, these impacts may become significant.

Relative Effects of the Recreation Alternatives

Alternatives for Availability of Southern Access

Unescorted southern access to Reserve trails (Alternative 3A) could result in additional soil erosion and sedimentation of aquatic habitats. Unescorted trail access results in a greater potential for increased soil erosion from increased trail use, switchback cutting, and off-trail hiking, particularly along watercourses. Off-trail hiking along watercourses could also lead to more frequent disturbances to fish. These are potentially significant impacts. The current and preferred approach of limiting the southern access to guided tours (Alternative 3B) would have substantially less potential for such adverse impacts. Alternative 3C would reduce the current small potential for adverse effects on fish and fish habitat because no access to the southern boundary would be provided at all.

Alternatives for Extent of Trail System

Under all alternatives, use of the Elk River corridor would be intensive, and the types of impacts previously described would all occur. The trail is near the river throughout the 2.9-mile reach, and new spur tails (except under Alternative 4D) would lead to riverbank areas. As noted, law enforcement activities can be focused in this area, and impacts can probably be minimized.

New trail construction and the more extensive use it would cause in the core of the Reserve under two alternatives could result in additional soil erosion and sedimentation of aquatic habitats, particularly where trail features are close to watercourses or on steep slopes. Alternative 4A, which has the most extensive trail system of the four alternatives, would run the greatest risk of direct disturbance of fish by visitors because of the extensiveness and remoteness of the proposed trail network, the difficulty to provide adequate security patrol, and the proximity of the trail

network to perennial streams. A minimum of four crossings of perennial streams would be involved beyond the Elk River corridor. The potential fish and aquatic habitat impacts of alternative 4A are considered significant.

Under Alternative 4B, the new trail network would be less extensive than under Alternative 4A (without the Alicia Pass Loop Trail and the two north-south connecting trails) and thereby entail only two stream crossings. The difficulties in patrolling the north-south connecting trails would be eliminated.

Under the no-action alternative (4D), two stream crossings beyond the Elk River corridor are also involved. However, the potential for adverse impacts on fish and aquatic habitats under this baseline alternative would be less than those for Alternative 4B because the extent of the trail network would be considerably less.

Alternative 4C would beneficially affect fish and aquatic habitats in the Reserve because only the New Elk River Corridor Trail would be accessible to visitors.

Alternatives for Bicycle Use

Trails accommodating bicycle use would increase maintenance needs. Surface soil erosion exacerbated by bicycle use would require increased maintenance. Bicycle use also affects trail surfaces to a greater degree than hiking, tending to dislodge more sediment and increase sediment yield during precipitation events.

As a result, bicycle use would tend to increase sedimentation of aquatic habitats. The greatest potential for soil erosion and sedimentation would occur where trails have steep gradients or cross slopes, lie near streams, or are used during periods when soils are saturated. This effect would be greatest for the alternative allowing the most extensive bicycle use (Alternative 5A), particularly along the steeper Salmon Creek Trail. The impact of this alternative is potentially significant. Under Alternative 5B, bicycling would only be permitted along the Elk River corridor; therefore, the potential for sedimentation impacts would be less. Because the existing trail in the Elk River corridor is on a preexisting roadbed of sufficient width to accommodate bicycles and has gentle trail gradients, this effect could be largely prevented through site-specific redesign of problem segments. Under the no-action alternative (5C), bicycle use would continue to not be accommodated on any of the trails in the Reserve, precluding any increase in erosion and sedimentation of aquatic habitats.

Alternatives for Equestrian Use

As with bicycle use, trails to accommodate equestrian use must be designed and maintained to a wider standard to reduce the conflict inherent in providing access for different types of users. Whereas trail widths of 3–4 feet may accommodate hikers, trail widths of 5–6 feet are needed to allow concurrent hiking and equestrian use. Depending on the steepness of the terrain that is traversed, wider trail width may require considerably greater total width of construction disturbance, volume of material moved, and area of cut- and fill-slopes exposed to precipitation and runoff. As previously noted, such trails would be more than the minimal necessary facilities needed to provide for public access to the Reserve.

Trails accommodating equestrian use would also increase maintenance needs. Wider trail sections result in larger volumes of earth placed in unnatural, less-stable configurations and wider

disturbed surfaces exposed to precipitation and runoff. With relatively larger potentials for both mass instability and surface erosion, such trails inherently require more maintenance. Equestrian use also impacts trail surfaces to a greater degree than hiking, dislodging more sediment and increasing sediment yield during precipitation events.

As a result, equestrian use would tend to increase sedimentation of aquatic habitats. The greatest potential for soil erosion and sedimentation would occur where trails have steep gradients or cross slopes, lie near streams, or are used during periods when soils are saturated. This effect would be greatest for the alternative allowing the most extensive equestrian use (Alternative 6A), particularly along the steeper New Little Salmon Creek Trail. The impact of this alternative is potentially significant. Under Alternative 5B, equestrian use would only be permitted along the Elk River corridor; therefore, the potential for sedimentation impacts would be less. Because the existing trail in the Elk River corridor is on a preexisting roadbed of sufficient width to accommodate bicycles and has gentle trail gradients, this effect could be largely prevented through site-specific redesign of problem segments. Under the no-action alternative (5C), equestrian use would continue to not be accommodated on any of the trails in the Reserve, precluding any increase in erosion and sedimentation of aquatic habitats.

Effects of Recreation on Wildlife

Effects of Management Common to All Recreation Alternatives

Terrestrial habitats or wildlife would not directly benefit from public access to the Reserve. However, indirect benefits to these resources could result from increased public awareness of the unique forest resources of the Reserve as a result of interpretive walks and school and community outreach programs.

Wildlife resources could be adversely affected by human access into the Reserve. Potential impacts differ primarily by the extent of the trail system developed in the Reserve, the timing of access, and by the type of uses accommodated. A variety of uses has been proposed—walking/hiking, horseback riding, bicycling, and dog exercise—all of which have the potential to adversely affect wildlife.

This section has two parts. The first part assesses the beneficial implications of individual elements of species management direction for all alternatives. The second part assesses the effects on various species or species groups addressed in chapters 3 and 4.

Effects of General Management Direction

Prohibition of Off-Trail Hiking, Possession of Firearms, and Fishing

A major protection of wildlife at the Reserve under all alternatives will result from the prohibition of off-trail hiking. By restricting recreationists to existing trails, disturbance becomes more predictable to wildlife, and wildlife species will either avoid the trails or become more tolerant of nearby human activity (Papouchis et al. in prep.). The prohibition of firearms and fishing would reduce the temptation for users of the Reserve to violate the prohibition on off-trail hiking.

Overnight Camping

A second major protection of wildlife would result from the closure of the Reserve to overnight camping. Many wildlife species are active during dawn and dusk (crepuscular periods). By restricting use during these hours, impacts on wildlife will be greatly minimized.

Corvid Management

An indirect, adverse impact that may result from public consumption of food at the Reserve is the potential for corvids and other human commensal species to colonize areas of the Reserve. Use of guidelines for corvid control presented in chapter 4 are intended to minimize or eliminate human food wastes, and enforcement of regulations in this regard will be critical to the success of these measures. Corvid populations will be intensively monitored for the next three years and thereafter as appears warranted. If minimization measures are not effective, new measures would be established. The potential for corvids to impact wildlife is discussed in more detail under "Effects on Marbled Murrelets."

Trail Use Restrictions

Access to trails will result in direct disturbance to a small amount of habitat and the potential for noise from human activity to disturb wildlife inhabiting surrounding areas. In particular, human activity could disturb nesting birds, resulting in the abandonment of the breeding effort by failure to initiate nesting, failure to complete incubation, disruption of feeding young, or premature dispersal of juveniles. However, given the anticipated intensity of use, it is unlikely that this infrequent disturbance would significantly affect breeding birds.

Access to central portions of the Reserve would be restricted on seasonal and hourly bases, depending on trail proximity to suitable and occupied marbled murrelet and northern spotted owl habitat. These seasonal closures will protect nesting of these species and simultaneously reduce impacts on other wildlife species within the established no-disturbance buffers. The overnight camping closure will minimize impacts on those wildlife species active during crepuscular periods.

Dog Control

Direct impacts on wildlife from the dogs in the Reserve will be minimized by limiting dogs to the Elk River corridor and requiring that they be leashed. Enforcement of dog-control regulations will be critical to the success of these measures.

Effects on Common Wildlife

A change in species composition in the vicinity of trails is predictable. Wildlife sensitive to human presence will avoid trails, while those wildlife species tolerant of human presence will inhabit these corridors.

Common wildlife in the areas immediately adjacent to proposed trails (up to 250 feet) may be adversely affected by noise disturbance (Miller et al. 1998). Among alternatives considered, this area of disturbance ranges from approximately 180 acres to 980 acres (table 6-6), or 2.4–13.2% of the Reserve. As the harvested forests at the Reserve mature, noise attenuation will increase, and this area will diminish.

The five elements of species management direction described above will minimize impacts on common species. These initiatives will be implemented through educational signs and programs about wildlife disturbance and through enforcement of compliance with regulations.

Table 6-6. Area of Wildlife Habitat Disturbance for the Recreation Alternatives

Alternative	Habitat Directly Disturbed (acres)	Habitat Subject to Potential Noise Disturbance (acres)	Total Habitat Disturbed (acres)
4A: Extensive old-growth contact experience	11.7	976.0	987.7
4B: Limited old-growth contact experience (preferred)	6.7	555.7	562.4
4C: No old-growth contact experience	2.1	177.7	179.8
4D: Existing trail system (no action)	5.5	460.4	465.9

Effects on Migratory Birds

Migratory bird species with a low tolerance for human disturbance may be adversely affected by human activity in the Reserve. Populations of migratory bird species that are tolerant of human use in and around the trails will increase.

Recreation use of trails may interrupt normal breeding behavior of these birds and prevent sensitive and rare birds (e.g., pygmy nuthatch) from nesting in the vicinity of trails (Miller et al. 1998). In most of the Reserve, this impact will be avoided by the seasonal and camping closures for marbled murrelet and spotted owl. Restricting human activity to trails will help greatly to minimize the impact on breeding migratory birds. Some limited insignificant adverse impacts may occur.

Effects on Marbled Murrelet

Suitable habitat for the marbled murrelet would not be directly altered as a result of recreation activities. New trail construction will be undertaken outside of the nesting season.

Under more extensive access alternatives, human activity in the vicinity of and along trails in the Reserve could cause direct disturbance to nesting marbled murrelets. Individual murrelets will differ in their responses to human activity, possibly depending on degree of habituation. For example, in Big Basin Redwoods State Park (Santa Cruz County, California), nesting marbled murrelets are relatively tolerant of humans traveling on trails adjacent to nests (Singer et al. 1991 and 1992). However, Hamer and Nelson (1998) observed adults delaying or aborting feeding and incubation exchanges as a result of humans on the ground near the nest tree. However, at the Reserve, potential disturbance from hikers will be minimized through the implementation guidelines specified in chapter 4.

Visitor use in the Reserve may cause an increase in corvid species, which are attracted by human food wastes and may then prey on nesting murrelets. As discussed in chapters 3 and 4, nest predation may be the primary cause of nest failure and depressed reproductive rates in the marbled murrelet (Singer et al. 1998, Marzluff and Balda 1997, U.S. Fish and Wildlife Service 1997). Picnic sites will be located in the Elk River corridor, which is relatively distant from the old-growth groves. Nevertheless, corvids attracted to the corridor for feeding would be able to easily probe into the central portions of the Reserve. To the degree that behavior of hikers cannot be controlled, the discarding of food wastes at any location along the trails system must be anticipated. Under some alternatives, these trails are within or adjacent to suitable and occupied

marbled murrelet habitat. This impact might be reduced through the seasonal and camping closures of trail systems adjacent to marbled murrelet habitat, but it is postulated that corvids develop affinity for the trail network during periods when the trails are open and will return during the closure periods. There may be some unquantified, unmitigated adverse impacts.

Effects on Northern Spotted Owl

Suitable habitat for the northern spotted owl would not be directly altered as a result of recreation activities. New trails will not displace nesting, and trail construction will be undertaken outside of the nesting season.

The potential for human activity to disturb nesting owls will be minimized through use of implementation guidelines given in chapter 4. There may be some unquantified, unmitigated adverse impacts.

Effects on Bald Eagle, Peregrine Falcon, and Osprey

Suitable habitat for these birds would not be altered or degraded as a result of trail development or use. New trails will not displace nesting, and trail construction will be undertaken outside of the nesting season. These birds, very few in number historically, can use portions of the Reserve that are distant from trails for nesting or roosting.

Effects on Amphibians, Reptiles, and Survey-and-Manage Species

These species, described in chapter 3, could be affected by the construction of stream trail crossings. New trails will not destroy any such species. If they are encountered, these species would be temporarily relocated if considered feasible by a qualified habitat specialist. Over the long-term, new trails to be constructed under several alternatives would contribute additional sediment to streams, which may adversely affect amphibian habitat.

Relative Effects of the Recreation Alternatives

Alternatives for Availability of Southern Access

Unescorted southern access to Reserve trails (Alternative 3A) could result in off-trail hiking (including entry into old-growth groves), violations of seasonal and camping closures to protect nesting murrelets and spotted owls, discarding of food wastes that may attract corvids, possession of firearms, hunting, fishing, and entry by dogs. Currently, and under alternative 3B, these potential impacts are avoided because visitors are accompanied by rangers who oversee visitor activities and educate visitors about these types of impacts. Alternative 3A would require that a significant enforcement program be initiated from the southern trailheads, similar to that now provided from the northern trailhead. Impacts to wildlife would occur, however, because total enforcement of restrictions to prevent these types of impacts is impossible, given the area involved. These potential impacts are considered significant.

Alternative 3C would not provide for public access to the southern portion of the Reserve. This alternative would benefit wildlife resources in comparison to the existing management scheme. The absence of human entry would enlarge habitat for species sensitive to human presence and

preclude any of the impacts described above. Thus, the no-southern-access alternative would result in a preserve-like habitat throughout the southern portion of the Reserve.

Alternatives for Extent of Trail System

Trails in the Reserve would pose two unavoidable significant impacts: dispersed human consumption of food that will at times be accompanied by discarding of food wastes that attract corvid and human noise disturbance to areas immediately surrounding trails. These potential impacts are related to the extent of the selected trail system, primarily those portions within the old-growth groves, but, in terms of noise disturbance, along other trail segments as well. As previously noted, USFWS considers that the zone of potential disturbance to marbled murrelets and spotted owls caused by trails generally extends 0.25 mile beyond the trails (USFWS 2000). Also as previously noted, disturbance to many other nesting birds extends up to 250 feet from the trails. The latter may be assumed to represent the zone of general wildlife disturbance caused by trails.

Extensive Access Alternative

Alternative 4A proposes access to nine trails (table 5-2), directly impacting 12 acres (or more, if wider trails are constructed for equestrian or bicycle uses) and indirectly impacting general wildlife over approximately 990 acres, or 13.4%, of the Reserve (table 6-6). Seven of these trails would be newly constructed trails in areas where no trails currently exist. Two north-south connecting trails would be constructed, which would pass through the central old-growth grove of the Reserve (figure 5-1). The historic Military Ridge Trail would traverse the center of the largest grove of old-growth forest in the Reserve, passing through it for 2.4 miles. The Western Periphery Trail would pass through a much shorter portion and be located near the edge of the grove. To accommodate traversing the long lengths of the north-south connecting trails, camping would need to be allowed at a specified site outside of, but near to, the old-growth groves.

This alternative poses several significant risks to special-status and other wildlife species associated with this alternative. Overnight camping would require development of additional infrastructure and administrative access. Overnight camping would also greatly increase the potential for human food availability to corvids, potentially facilitating predation on nesting murrelets. As previously noted, use closures in the breeding season would only partially reduce this effect. Because it would be difficult to monitor and enforce regulations along the north-south connecting trails, especially the historic Military Ridge Trail, the risk of off-trail hiking or on-trail hiking during night hours would increase. Murrelets or other wildlife intolerant of human disturbance would be adversely affected (figure 6-1). In addition, the risk of fire ignition would be greatly increased because of both the provision of overnight occupancy and the dispersal of visitors over large areas of the Reserve. The potential impacts of Alternative 4A are considered significant.

Limited Access Alternative

Alternative 4B proposes access to six trails, directly impacting seven acres and indirectly impacting general wildlife over 555 acres, or 7.5%, of the Reserve. Four of these trails would be newly constructed trails in areas where no trails currently exist. Under this alternative, only the Universal Access Trail and the loop at the upper end of the New Little South Fork Trail would enter old-growth habitat. The former is within 0.25 mile of a marbled murrelet site; therefore, it would be closed during the breeding season for this species. The group of existing and proposed Salmon Creek trails do not actually enter old-growth habitat but pass adjacent to it. Because they are also within 0.25 mile of occupied marbled murrelet habitat (figure 6-2), these trails would also be closed during the breeding season.

In disallowing north-south connecting trails, alternative 4B would result in much less potential for impacts on wildlife, as described above, compared to Alternative 4A. However, in comparison to current conditions, this alternative increases the general wildlife disturbance zone from 4.9% to 7.5% of the Reserve.

Maximum Preservation Alternative

Alternative 4C proposes access to one trail—the Elk River Corridor Trail—directly impacting two acres and indirectly impacting general wildlife over approximately 180 acres, or 1.9%, of the Reserve. This alternative reduces impacts on wildlife relative to the existing access alternative (4D). Under this alternative the only trail available for public use would be the Elk River Corridor Trail passing through second-growth forest and riparian habitat. No access would be provided to or near any of the old-growth groves of the Reserve (either from the north or the south). Illegal off-trail hiking to reach old-growth groves would be very arduous after road removals and revegetation actions were complete. This alternative would provide a relative benefit to old-growth-dependent species by eliminating the possibility of impacts to nesting owls and murrelets, preventing direct or noise disturbance to old-growth habitats, reducing opportunities for corvid intrusions, and greatly minimizing the risk of fire ignition.

Existing Access Alternative

Alternative 4D (no action) would continue to provide access to three trails, directly impacting 5.5 acres and indirectly impacting general wildlife over 460 acres, or 4.9%, of the Reserve. All of these trails would continue to be open in the daytime during the marbled murrelet breeding season, possibly subject to morning and evening closures that have yet to be determined. The Little South Fork Elk River Trail ends near the northern border of the central old-growth grove. The Salmon Creek Trail passes near the border of the same grove. Both locations are within 0.25 mile of occupied marbled murrelet habitat (figure 6-3). Impacts would continue to be minimized by prohibiting overnight camping and employing backcountry rangers to enforce restrictions.

Alternatives for Bicycle Use

Although it is unlikely, bicycle use within the Reserve has the potential to suddenly disturb, injure, or kill wildlife. However, scientific studies have not been found that address the potential for bicycle use to impact wildlife. Wildlife effects have been cited by managers of Mount Tamalpais State Park as a concern in bicycle-use management at that site (May pers. comm.).

Alternative 5A would allow bicycle use on the relatively steep Salmon Creek Trail, where this potential impact would be greatest. Alternative 5B would allow bicycle use along the relatively gently sloping Elk River Corridor Trail. Alternative 5C would ensure the least amount of disturbance to wildlife by not allowing bicycle use within the boundaries of the Reserve. In the absence of evidence that bicycle conflicts with wildlife have been significant, none of these alternatives is considered to result in a significant adverse effect on wildlife.

Alternatives for Equestrian Use

Impacts on wildlife resulting from equestrian use within the Reserve include the potential for horses to disturb wildlife, horse feces to transmit diseases to wildlife, and increased sedimentation in streams. The latter was discussed in the section above, “Effects of Recreation Management on Aquatic Ecosystems.”

Scientific studies have not been found that address the potential for horses to disturb wildlife or transmit disease to wildlife. There are a few studies on the potential for horses to transmit diseases to humans and some professional opinions on the potential for horses to transmit diseases to wildlife.

Equestrians have suggested that horses may be less disturbing to wildlife than hikers; however, this argument is supported through anecdotal evidence only. In the absence of contrary evidence, it is assumed that equestrian use poses no additional threats to wildlife than pedestrians.

Most research on wildlife disease examines the potential for wildlife to transmit disease to humans. Intensive studies on commercial livestock have identified a number of microorganisms, including *Cryptosporidium parvum*, *Giardia duodenalis*, *Campylocbacter* ssp., *Salmonella* ssp., and pathogenic strains of *E. coli* and *Yersinia* ssp., in horse intestines (Quinn 1998). Correspondence with veterinarians and microbiologists at the University of California, Davis, indicates that the presence of these pathogens in horses is extremely rare, and there is little evidence that these pathogens can be spread through feces to humans (Baker pers. comm., Quinn 1998).

The organisms that horses could potentially transmit to wildlife include some of the intestinal strongyle parasites, the liver fluke *Fasciola hepatica*, the lung worm *Dictyocaulus arnfieldi*, various species of lice, and the parasitic mites *Psoroptes* and *Chorioptes* (Teglas pers. comm.). If horses are dewormed regularly, receive adequate veterinary care, are watered by nonpermanent sources separated from aquatic habitats, and pastured on dry land, the risk of transmission of these parasites to wildlife would be minimized. Actions to achieve measures described in the implementation guidelines for equestrian use in chapter 4 will be implemented at the Reserve.

Other than increased potential for sedimentation of streams caused by trail wear, discussed in "Aquatic Ecosystem" above, introduction of equestrian use into the Reserve would not be expected to have a significant adverse effect.

Effects of Recreation Management on Cultural Resources

The recreation program will indirectly benefit the Reserve's cultural resources by committing financial resources to deriving information about the Reserve's prehistoric and historic uses and fostering public support for protection, evaluation, and interpretation of these resources.

Potential Direct Adverse Effects

Potential direct adverse effects include disturbance of undiscovered resources during development of recreation facilities, including new trails (under three of four alternatives), new trailheads, expanded trailhead parking areas (to accommodate equestrians under two alternatives), and picnic sites and a pavilion in the Elk River corridor. Disturbance could also result from installation of interpretive signs and fences at known cultural resource sites.

Plans for siting trails and other facilities will be developed in consideration of the detailed information provided in the cultural resources survey (Humboldt State University Academic Foundation 2001). Ground disturbance near any of the identified sites will be avoided. Moreover, before trails or any other improvements are constructed at the Reserve, planned work areas will be surveyed for cultural resources, and if any are encountered, the project will be

appropriately modified based on evaluation by a qualified archaeologist. If any cultural materials or sites are encountered during construction, all work will be stopped until a qualified archaeologist has evaluated the find. Based on these protocols, potential direct impacts on cultural resources from the recreation program are considered less than significant.

Potential Indirect Adverse Effects

Members of the public are showing interest in the Reserve's cultural resources by incidentally and intentionally collecting and looting artifacts. Expanding public use of the Reserve would tend to magnify this continuing adverse indirect effect. For the most part, these types of impacts will be controlled and, hopefully, eliminated by proposed protection measures described in chapter 4. Those measures include collection by qualified archaeologists, fencing, signing, and providing security patrol and public outreach. It is feasible to provide an adequate level of patrol and public contact in the 2.6-mile Elk River corridor where most of the resources are situated.

Patrol and public contact to protect the prehistoric site would be difficult for the trail-extent alternative that allows public use of the historic military ridge trail (4A). The site is adjacent to the trail in a remote part of the Reserve, where it would be time-consuming and costly to provide a security patrol. Ironically, alternative 4A might provide a benefit to the historic trail itself, because keeping an old trail in use has the potential to preserve it better than another approach. However, this benefit of continuing use may be better provided by resource monitors and researchers who use this trail for access to study sites in the old-growth grove. Regardless, the potential for unpreventable damage to the prehistoric site, until the site can be collected or its significance determined, is considered a potential adverse effect of Alternative 4A.

Socioeconomic Effects of Recreation Management

Effects of Management Common to All Access Alternatives

Recreation will provide Reserve visitors the social, spiritual, and intellectual benefit of increased knowledge of old-growth resources and functions.

Public road access to the northwestern end of the Reserve will continue to be provided by Humboldt County's Elk River Road. Reserve visitors using this route will continue to stimulate retail business in Eureka. Because Eureka is a large, regional commercial center, such a stimulus was not discernable with the opening of the Reserve and would not be expected to be discernable under any of the public access alternatives.

Under all alternatives, traffic along Elk River Road to the Reserve will continue and will vary in magnitude according to the alternatives selected. This traffic will continue to annoy or disturb some of the residents bordering the road, especially those whose occupancy predated creation of the Reserve. A decrease in safety of local residents has not occurred with creation of the Reserve, however, and would not be expected to develop under any alternatives. Standard traffic management measures would be taken by the county to alleviate any development of a safety hazard.

Seasonal and daily restrictions on trail use to protect nesting marbled murrelet and northern spotted owl and to protect trails from water damage will continue to cause predictable fluctuations in traffic flow and associated visitor impacts on local residents.

Relative Effects of the Access Alternatives

Alternatives 3A, 3B, 4A, 4B, and 4D would continue to provide southern Reserve access to the Salmon Pass Trailhead via Newburg and Felt Springs Roads. These alternatives would benefit retailers in the nearby community of Fortuna to a minor but perhaps discernable degree. Residents along Newburg Road would continue to be disturbed by traffic to the Reserve under all of these alternatives. Because the unescorted vehicle access alternative (3A) and the more extensive trail system alternatives (4A and 4B) would tend to increase visitation to the Reserve relative to existing conditions, local resident annoyances may increase under those alternatives. The magnitude of anticipated increases in visitation under these alternatives is relatively small. Traffic safety has not diminished on this road since the Reserve was opened, and traffic management measures are available to Humboldt County to preclude safety from diminishing with the increased levels of visitation that would be expected under any of the alternatives.

Alternatives accommodating bicycling or equestrian uses in the Reserve (5A, 5B, 6A, and 6B) would increase total visitation to the Reserve. The magnitude of the increases is difficult to predict but would be expected to be relatively small. The largest effect would be on the Elk River Road because all equestrians would use this access and annoyance to local residents may be further increased by the passage of trucks pulling horse trailers. Traffic safety would not be expected to significantly diminish, and, as previously noted, measures may be taken by Humboldt County to ameliorate any such effects. The inconvenience of increased and changed vehicle traffic caused by equestrian access will be small and is not considered to be a significant impact of the equestrian use alternatives.

Effects of Recreation on Fire Behavior and Management

Public visitation will affect ignition risk. This risk is largely a function of the extent of the trail system in forest types that are particularly flammable. An assessment of the synergistic effects of forest restoration alternatives and public access alternatives was previously discussed in “Forest Restoration, Effects on Fire Behavior and Management”. In that assessment, it was concluded that trail system Alternatives 4A and 4B would cause a significant increase in the exposure of highly flammable stands to public visitation, and, in the absence of forest restoration (Alternative 2C), this increase would be a significant impact of these alternatives.

Effects of Recreation on Resource Monitoring

Increased access to the Reserve will require a greater level of monitoring of trail conditions and impacts to biological resources. The proposed monitoring plan is given in chapter 4. Unescorted southern access, old-growth contact, and bicycle and equestrian uses permitted under Alternatives 3A, 4A, 4B, 5A, 5B, 6A, and 6B will all contribute to the need for increased monitoring of trail conditions and biological resources. These monitoring needs are not considered significant impacts of these alternatives.

Management of Designated Special Areas

The primary effect of special-area designation(s) would be to constrain allowable uses or management actions that might otherwise be allowed or undertaken. These constraints were

noted in "Alternatives for Special-Area Designations" in chapter 5. In this section, the management and environmental implications of each constraint are assessed.

Table 6-7 shows the four special-area designations that would constrain the management direction assessed in this plan as well as the constraints and environmental implications relative to proposed management of the Reserve common to all alternatives (described in chapter 4).

Wilderness Study Area

In WSAs, forest restoration can be allowed only if it is temporary in nature and creates no new surface disturbance. The only relevant exception to this rule is if the activity clearly protects or enhances wilderness values or is the minimum activity necessary to protect public health and safety in the use and enjoyment of the wilderness values (DOI BLM 1995b). The proposed forest restoration actions, which are intended to accelerate the recovery of old-growth characteristics in the Reserve's second-growth forests over the long term, do not "clearly protect or enhance wilderness values" in the near term. However, by accelerating recovery of old-growth values, forest restoration actions will enhance wilderness values over time. This constraint, when applied to the WSA designation alternative, would reduce the extent of action of forest restoration Alternative 7A by different amounts, thereby affecting the degree of recovery of old-growth characteristics and reduction in fire hazard (table 6-7).

The alternative WSA designations would have no effect on proposed recreation, with one exception. Development of trail systems in WSAs is not precluded, nor is it required. The development of support facilities (e.g., parking areas, restrooms, trailheads, pavilion, picnic sites) under consideration would occur outside of either WSA designation considered. Hiking and equestrian uses of trails are not precluded. However, "no mechanical transport, which includes all motorized vehicles plus trail or mountain bikes, will be allowed on such (WSA) trails" (DOI BLM 1995b). In the case of the Reserve, bicycle use is being considered for only one trail inside of the more extensive WSA under consideration (Alternative 7A) and not anywhere in the less extensive WSA alternative (Alternative 7B). Thus, if the more extensive designation is selected, alternative 5A (allowing bicycle use on wider trails) would be precluded.

Wild and Scenic River

Wild and Scenic River designation would not impose any additional management requirements on the lands to be included that are not already part of the proposed management direction of this plan. The use of mechanical equipment for watershed restoration is acceptable because these activities will improve aquatic ecosystems by reducing the potential for landslides and surface erosion to contribute sediment to streams. Likewise, the accelerated development of mature forest cover would have long-term beneficial effects on water quality. Because tree and brush removal would be excluded from riparian zones, direct short-term effects on the stream environments would not occur.

Wild and Scenic River designation segments would also have no effect on recreation under consideration. Development of trails systems; trail use by hikers, bicyclists, or equestrians; and development of support facilities, such as parking areas, restrooms, trailheads, interpretive pavilions, and picnic sites, would not be precluded by designation.

State of California Ecological Reserve

As indicated on table 6-7, designation of a State of California Ecological Reserve (appendix I) could impose several limitations on activities that would not otherwise be precluded by this plan. These restrictions would tend to further protect ecological integrity (e.g., no possession of firearms, no camping, no campfires, no hovercraft or aircraft), but they might tend to suppress public visitation (no camping, no swimming). Prohibition of hovercraft or aircraft may also interfere with helicopter logging on adjacent timberlands or interfere with emergency fire suppression activities.

The effect of a no-camping restriction would only affect users of the north-south connecting trails under Alternative 4A, if that alternative were selected. Such a restriction would not be an adverse effect relative to the impact baseline because camping is not currently allowed in the Reserve.

It is impossible to estimate the effect of a no-swimming restriction, but streams in the Reserve do not provide particularly good swimming opportunities. The impact of this restriction is considered less than significant.

Effects of a no-aircraft restriction on fire suppression and commercial helicopter logging activity on adjoining lands could be significant. These potential adverse effects could be reduced to a less-than-significant level by specifically allowing these uses in some or all of the Reserve in the ecological reserve designation.

Resource Monitoring and Evaluation

The benefit of resource monitoring and evaluation is in providing a scientific database on which future management decisions may be based. This plan sets forth certain needed actions and allowable uses, and the effects of those actions and uses need to be assessed. Based on such observations, adaptive management may be pursued. Changes in management may be made to modify implementation of the plan direction, modify plan direction itself, or even modify plan goals/decisions. The latter two modifications would require a plan amendment or revision (chapter 1).

Effects of Resource Monitoring on Ecological Resources

Protocols for all resource monitoring will be designed to be as nonobtrusive on ecological resources as possible. In no circumstances will monitoring be allowed to disturb special-status nesting birds or other wildlife or plants or cause an increase in sediment yield. The potential for monitors to attract corvids into the Reserve will be minimized by implementation measures in chapter 4 (“Research Management, Research Overnight Occupancy Guidelines”). None of the monitoring activities shown on table 4-7 would have any adverse effect on the Reserve’s resources.

Effects of Monitoring on Visitation

Monitoring would not intrude on visitors, other than by requiring that visitors continue to register in log books at trailheads. If visitor surveys were used, they would be voluntary in nature and

require approval from Office of Management and Budget to ensure that they do not burden visitors.

Management Revenue

Effects Common to All Management Revenue Alternatives

Imposition of use fees of the magnitude under consideration (chapter 4) would not be expected to significantly affect levels of visitation, based on results of BLM's fee demonstration program to date (appendix D; chapter 3). Recent experience at Patrick's Point State Park suggests, however, that the level of the fee may influence the type of use (i.e., interpretative versus sport). One purpose of the recent statewide reduction in state park fees was to encourage more use by lower-income persons. It is possible that fees under consideration for the Reserve would result in a somewhat changed profile of users, but a significant shift from current visitor types would not be expected.

Establishment of various user fees would be intended to derive revenue in proportion to the relative costs of providing access to the various user groups (e.g., equestrians and bicyclists require widened trails, greater trail maintenance, adequate parking facilities, additional law enforcement, development of watering sources [equestrians only]).

Relative Effects of the Management Revenue Alternatives

Fees would be charged to all visitors (Alternative 10A), only those participating in recreation tours (Alternative 10B), or those *not* participating in such tours (Alternative 10C). As noted above, any of these fee schemes would not be expected to significantly affect the magnitude and type of use of the Reserve.

A no-tour fee (Alternative 10C) would be a mild incentive to visitors to participate in guided tours rather than enter the Reserve individually and unaware of the possible implications of their visit. This approach has the benefit of increasing the number of visitors who can be taught the hazards of human behavior (e.g., discarding food scraps, hiking off-trail, disturbing nesting) on the ecosystem integrity of the Reserve. Also, the reduced level of individual use eases monitoring of visitor compliance with seasonal and hourly closures for marbled murrelet and spotted owl nesting.

A tour fee (Alternative 10B) would provide a source of revenue directly from the beneficiaries. It would not be expected to have environmental consequences.